E ENGINEERING CONSTRUCTION WEEKLY

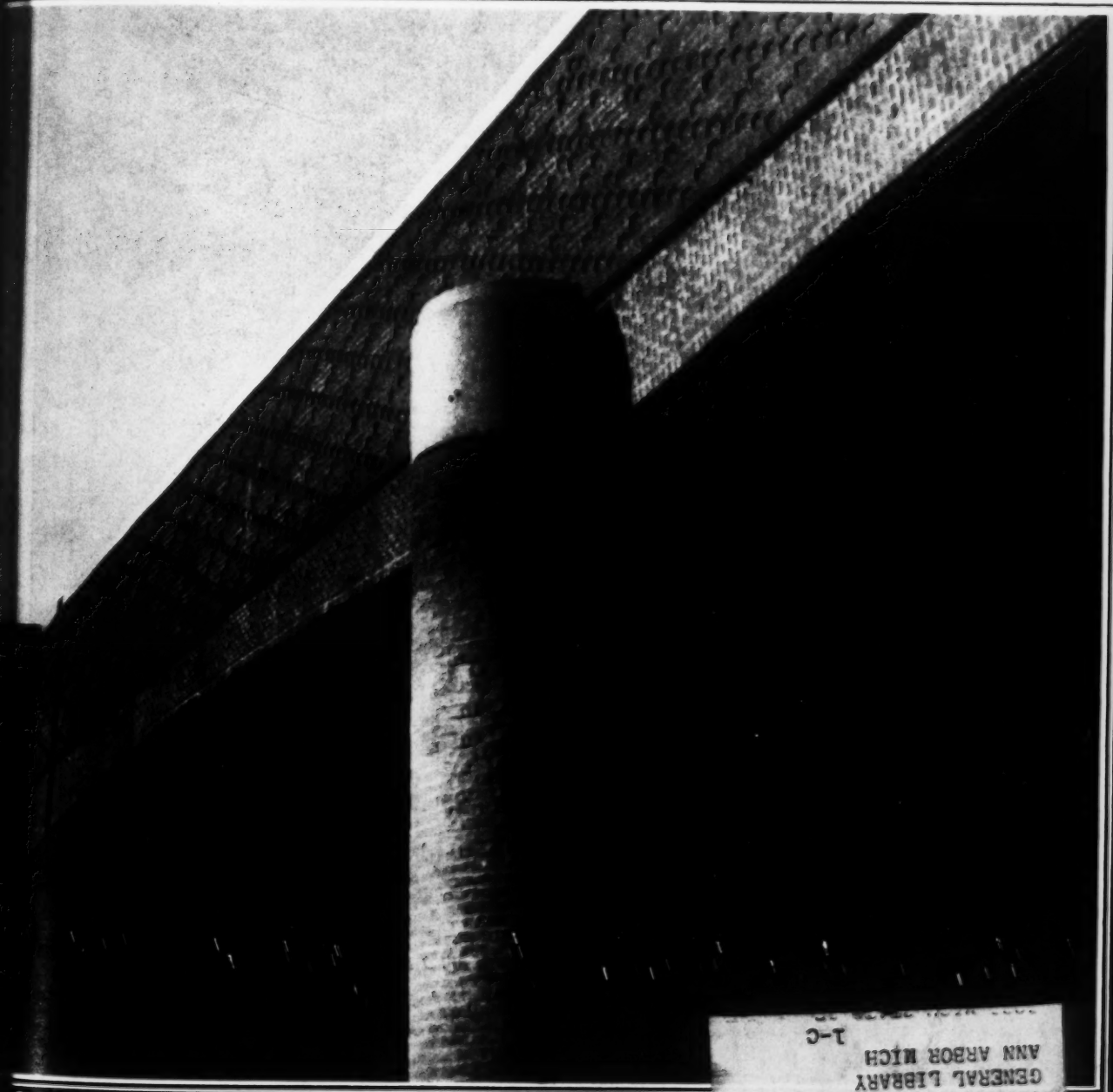
McGRAW-HILL PUBLISHING COMPANY, INC. · TWENTY-FIVE CENTS, FIVE DOLLARS PER YEAR

DEC 6 1937

Engineering Library

Engineering NEWS-RECORD

December 2, 1937



BRIDGES · IRRIGATION · FLOOD CONTROL · FOUNDATIONS · DAMS ·

GHWAYS · WATERWORKS · STR

UNIV OF MICHIGAN
GENERAL LIBRARY
ANN ARBOR MICH

1-C

END SEWER MAINTENANCE

With This Strong, Durable Pipe

There's no longer any need to tolerate broken, disjointed sewers. By designing with Armco's improved sewer pipe you definitely conquer those *structural* weaknesses that so often cause trouble in other types of sewer lines.

Made of sturdy corrugated iron, Armco sewer pipe has what it takes to withstand heavy loads and sudden impact. Then, too, since its long sections are jointed tightly into *one continuous line*, you can forget about tree roots and soft, yielding foundations.

Best of all, Armco sewer pipe gives you this *three-way* assurance of long *material* life: (1) A galvanized base metal proved by thirty years of sewer performance; (2) a special bituminous pavement and coating used successfully for 12 years; and (3) an Asbestos bond that keeps this bituminous material permanently on the pipe. For the complete story, simply address: Armco Culvert Manufacturers Assn., Middletown, Ohio.

Installing a 30-inch Asbestos Bonded Armco Sewer at International Falls, Minnesota.

ARMCO

A PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

ASBESTOS BONDED ARMCO SEWER PIPE

Do You Know, for Example, ... ?

NEXT WEEK *Engineering News-Record* will publish an important group of articles on modern trends in building design. They will be significant, not only for their exceptional fund of information, but also for the light they shed on current progress in building technique.

More and more it becomes evident that the genius of American technicians and engineers is finding a new outlet. During the next generation their work must deal more and more with the modernization and replacement of obsolete facilities rather than with the building of the original facilities required by a new and expanding country.

Of all the engineers, the civil engineer probably has been most concerned as to his place in the future scheme. He was the pioneer of national development. He laid down the highways of our progress, built and equipped our cities, pushed back the frontiers and made the new land habitable. Some, therefore, have professed to see the passing of the frontier as a portent of doom for the civil engineer.

But such a Hollywood conception of the civil engineer and his work is altogether too superficial. It forgets that modern science and technology touch civil engineering and construction just as closely as they do the other fields of technical practice. And under that touch the structures of the civil engineer become just as obsolete as do the motors, machine tools and native metals of industry.

CONSIDER, for example, the theme of next week's issue. Building is supposed by many to be fairly stabilized technically. We accept statistics of building supply and demand based on "floor-space." But what do we mean by "floor-space"? A square foot of "floor-space" is no more a measure of supply and demand than is "a lathe," "a motor" or "a ton of steel." Before that unit means anything we must know a lot more about *the kind of floor-space*. How well equipped and serviced is it? How accessible, how well lighted, how well heated, ventilated and air-conditioned?

These are but a few of the questions that must be answered before we can relate supply and demand for building. And if architects and engineers will apply technical progress to the obsolescence of current practice in their own fields, they surely will find markets for their services just as strong and as constant as those of their professional brethren in other fields.

TODAY the more aggressive of them are doing just that. A glimpse of their progress will be revealed by citing a few of the items that have been garnered by the editors during several months of preparation for next week's issue. They are but a tiny sample of the suggestive data that will make that issue of surpassing interest to every architect and engineer who expects continued employment in building design and construction.

Do you know, for example, that porcelain enamel steel sheets have been used to cover the walls of a large building and stainless steel for window sills and copings? That one air-conditioned building is inclosed by a 2¼-in. wall and another by a wall of prefabricated steel? That parking fields on the roofs of "taxpayers" are practical? That cement-asbestos sheets have been used for a 5-story building wall? That careful design of a welded building permits 90 per cent of the welds to be made in the shop? That glass blocks have been used to inclose monitor roofs? That continuous trusses permit 50 and 60-ft. square bays in industrial buildings with no more steel than is required for 30-ft. bays with simple trusses? That colored glass blocks in pilasters effectively conceal the columns behind them? That concrete columns are being designed smaller at the bottom than at the top? That small size wood block for floors are showing superiority over older types? And so on, with many more items of equal interest.

So long as structural engineers are alive to the need for and possibility of such developments, they will be able to generate a strong and sustained building activity during the years just ahead of us. And to help in some measure toward that end, next week's issue of this journal is dedicated.

Willard Chevalier

ENGINEERING NEWS-RECORD

Published every Thursday. Vol. 119, No. 23. Price 25c per copy. Subscription, domestic, Canada, Mexico, Central and South American countries, $5 per year. All other countries, $9 a year or 36 shillings. Entered as second-class matter October 29, 1936, at the Post Office at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Cable address "McGrawhill New York." Member A.B.P. Member A.B.C.

Copyright 1937 by McGRAW-HILL PUBLISHING COMPANY, Inc.

Editorial and Executive Offices: 330 West 42d St., New York. Publication Office: 99-129 N. Broadway, Albany, N. Y. Branch Offices: 520 N. Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

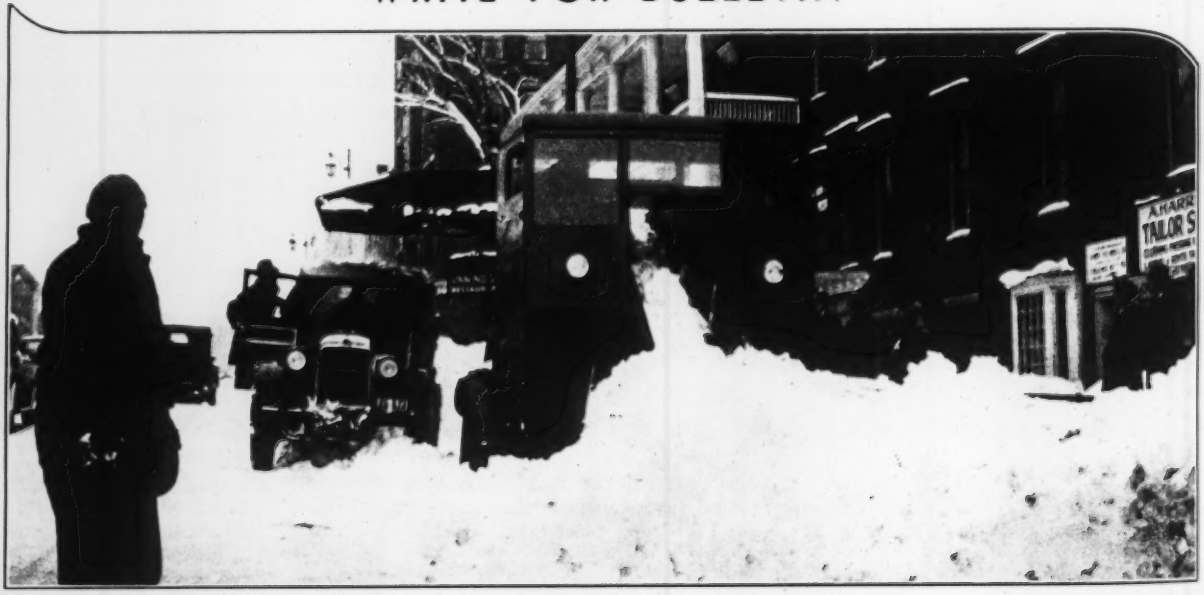
JAMES H. McGRAW, JR., President HOWARD EHRLICH, Exec. Vice President JAMES H. McGRAW, Honorary Chairman
WILLARD CHEVALIER, Vice President B. R. PUTNAM, Treasurer D. C. McGRAW, Secretary A. W. MORRISON, Circulation Manager

YOU CANNOT STOP SNOWSTORMS BUT YOU CAN OPEN YOUR STREETS

Quickly • Efficiently • Economically

WITH **JOY SNOW** LOADERS

WRITE FOR BULLETIN



JOY MANUFACTURING CO.
FRANKLIN · · · PENNSYLVANIA

· ENGINEERING NEWS-RECORD ·

McGRAW-HILL PUBLISHING COMPANY, INC.

WILLARD CHEVALIER, *Vice-President*

Editorial and Executive Offices: 330 West 42nd Street, New York . Publication Office: 99-129 North Broadway, Albany, N. Y.

F. E. SCHMITT, *Editor* ALBERT E. PAXTON, *Manager*

Copyright 1937

VOL. 119 *DECEMBER 2, 1937* No. 23

THIS WEEK AND NEXT

FRENCH DESIGN of rockfill dams in Algeria is undergoing a change. I. Gutmann tells how rock is carefully placed instead of loosely dumped, and how the trend is away from center core walls and toward an impervious upstream deck.

Experience at Fort Peck Dam has proved invaluable in the developing of materials for vital parts of dredge pumps to resist the devastating wear from pumping highly abrasive sands. In three dredging seasons the life of the pumps has been increased from five to ten-fold.

At the recent Conference on Residential Construction in Washington, the problem of reviving housebuilding was discussed by several national authorities.

Collapse of the 36-in. culvert that had been placed originally in a 66-ft. highway fill near Pittsburgh presented a problem which the engineers solved by jacking a new pipe through as miners removed material ahead of the cutting edge.

Old paving brick is being re-used as a cement-bound macadam aggregate in St. Joseph, Mo., street paving operations.

Sewage sludge may have a definite place in soil fertilization, according to a report made by a committee on that subject at the recent A.P.H.A. convention.

IN A SPECIAL ISSUE next week a dozen articles will be directed to the theme of "Buildings That Express New Trends." Remarkable disregard for design precedent and ingenious use of new materials have produced some amazing buildings during the past year. Since some of the buildings described may have a significant effect on the future of building design, next week's issue should prove interesting to every reader, building specialist or not.

		PAGE
News of the Week		877, 910
Reader Comment		884
Editorials		886
Pictures in the News		888
Algerian Dam of Placed Rockfill *(Impervious decks, Rockfill dams, Foundation conditions)*	I. GUTMANN	889
Thin Slab Railroad Bridge in Service 24 Years *(Grade separations, Reinforced concrete bridges)*		894
Fort Peck Dredge Pump Improvements *(Pump design, Dredging, Special alloys)*	T. B. JEFFERSON	896
Problems of Housebuilding Revival		901
Long Culvert Built by Jacking *(Highways, Tunneling)*	JOHN SCOTZIN	904
New Streets of Grouted Brickbats *(Municipal engineering, Highway design)*	M. H. SMALL	905
Sewage Sludge as Fertilizer		906
Zoning and Irrigation for the Great Plains		908
Sewage Notes		909
Materials and Labor Prices		913
New Aids to the Constructor	*Adv.page*	32
Construction Reports	*Adv.page*	35

DECORATIVE POSSIBILITIES OF BRICK in producing variety in grade separation structures are shown in the picture reproduced on the cover. It is of the face of a bridge that carries Newburyport turnpike over an intersecting road west of Saugus, Mass.

ENR Staff Photo

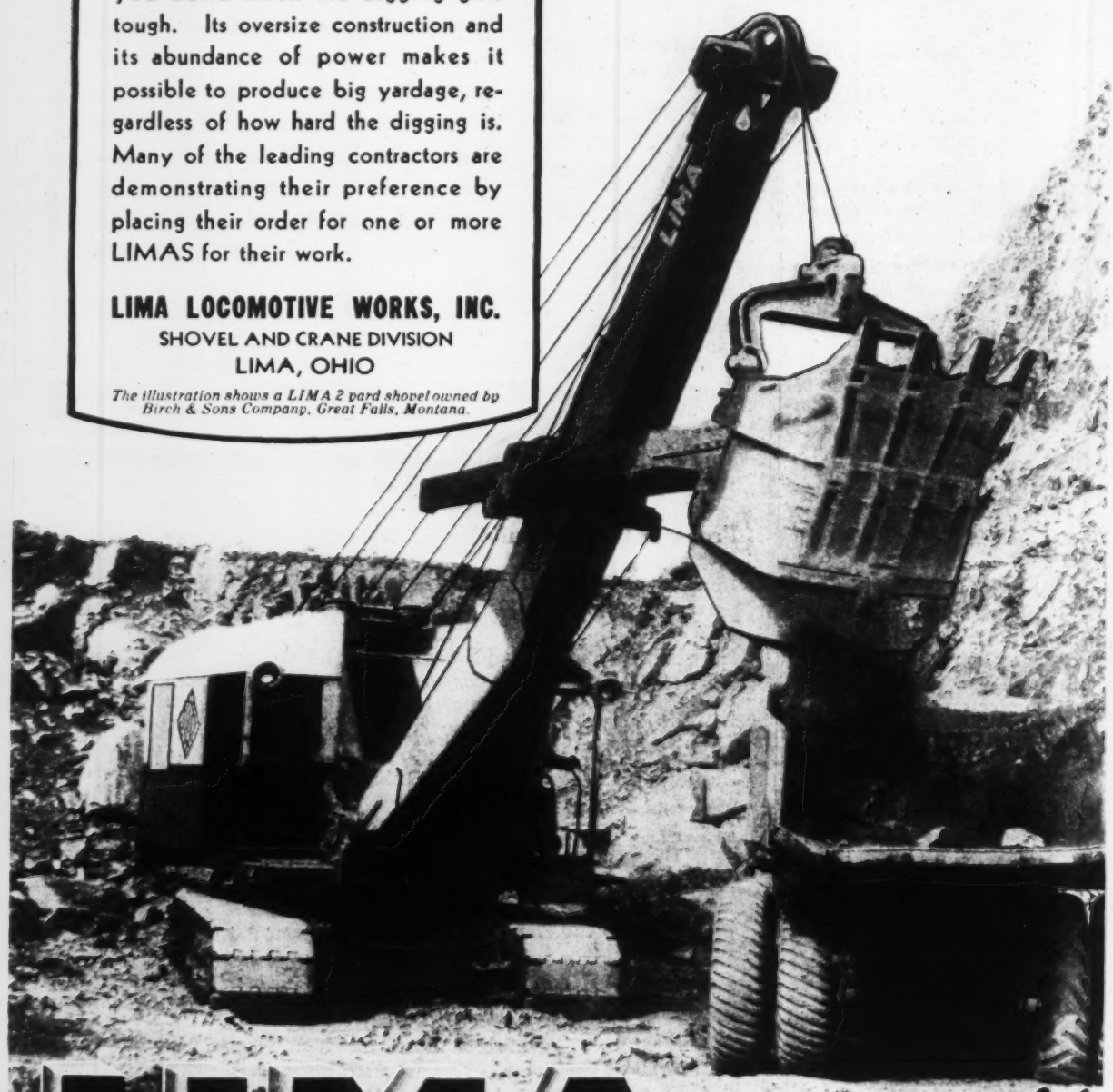
Number of copies of this issue printed: 30,863

The Favorite in Rock Digging

LIMA is a machine that won't let you down when the digging gets tough. Its oversize construction and its abundance of power makes it possible to produce big yardage, regardless of how hard the digging is. Many of the leading contractors are demonstrating their preference by placing their order for one or more LIMAS for their work.

LIMA LOCOMOTIVE WORKS, INC.
SHOVEL AND CRANE DIVISION
LIMA, OHIO

The illustration shows a LIMA 2 yard shovel owned by Birch & Sons Company, Great Falls, Montana.



LIMA Convertible

SHOVELS — DRAGLINES — CRANES — CLAMSHELLS

THE WEEK'S EVENTS

Building Stimulation Urged by President

Roosevelt proposes legislation to cheapen insurance of mortgages on private housing construction

Pointing out that "the long-continued lag in building is a drag on all industry and trade," President Roosevelt in a message to Congress Nov. 29 presented a program to stimulate a broad revival of housing construction both for sale and for rent and ranging from the small house to entire residential communities and large low-rent apartment buildings.

The President stated that the basic problem in stimulating increased production of housing for the middle income group is reduction of cost—cost of construction and cost of financing. The problem of reducing construction costs, he said, "is one that must be solved in major part by the building industry itself. The industry must develop means for efficient and economical large-scale production. The goal at which both industry and labor should aim is sustained large-scale production at lower cost to the consumer."

The President urged that a higher annual wage for labor in the building industries be achieved at lower hourly rates. He plans to initiate a series of conferences with representatives of industry, labor, and finance to achieve a general reduction in cost and increase in volume.

Financing charges

Although building costs must be reduced by private action, the government can, the President pointed out, reduce the financing cost. To this end he proposes legislation liberalizing and enlarging the scope of the National Housing Act of 1934, under which the Federal Housing Administration was established. He would continue the policy by which that agency insures mortgages but makes no loans itself, but he would reduce rates and increase the number of types of housing on which loans can be insured with a consequent reduction in financing charges.

The legislative program placed before Congress is intended to cover the small individual home, walk-up apartments, and large apartment buildings and large colonies of individual residences.

For small houses, to be occupied by the owner and not costing more than

(continued on page 880)

• • •

Activated Sludge Reduces Milwaukee Claim

A fifty per cent reduction in its patent infringement damage claim of $4,977,000 against the Milwaukee Sewerage Commission and the City of Milwaukee is provided for in a tentative offer made by attorneys for Activated-Sludge, Inc. Payment of the revised amount would be made by a down payment of $300,000, with the remainder paid in ten annual installments with 3 per cent interest. The city commission, however, is reported to feel that Milwaukee should be able to settle on the same population basis as have other cities; the city claims that such a basis would bring the amount down to $800,000. Ten years ago the use of the patent was offered to Milwaukee for about 3 per cent of that amount.

A U. S. District Court held, last June, (*ENR*, July 1, 1937, p. 5) that the city of Milwaukee had effected a saving of $4,977,000 by using the activated-sludge process of sewage treatment rather than an Imhoff-trickling filter type. This decision was contained in a memorandum drawn up preliminary to final settlement of the claim.

MAJOR NEWS

	Page
President's Building Message	877
Cut in Road Funds	877
Activated Sludge Claim Reduced	877
Hydro Power Cheaper	878
San Jacinto Work Normal	880
Chicago Traction Report	880
Los Angeles Landslide	881
Technicians Are Bargaining Unit	882
Federal-Aid Message	883

President Would Cut Road Funds

Reduction of 1939 authorizations and curtailment of future funds asked as economy measure

Cancellation of $218,000,000 of authorized road appropriations for the fiscal year 1939 and spreading of the authorizations for the present fiscal year (1938) over the years 1939 and 1940 is proposed to Congress by the President in a message delivered on Nov. 30. The full message is printed on p. 883.

The President points out that Congress in June, 1936 authorized appropriations of $238,000,000 for federal-aid highways, park roads, etc. in the fiscal years 1938 and 1939. For the present fiscal year (1938) actual appropriations under this authorization have amounted to only $38,000,000, leaving $200,000,000 yet to be appropriated. However, the federal government is committed to the appropriation of the major part of this money by state allotments announced by the Secretary of Agriculture last December. These obligations the President would meet by spreading them over two years, appropriating $100,000,000 in the budget for the fiscal year 1939 (beginning on July 1, 1938) and $100,000,000 in the fiscal year 1940.

Little construction

This is essentially the book-keeping operation to make the budget look better; it will have little effect on actual highway construction as this is about the rate at which the money will be called for under the existing administration program.

The President proposed to cancel the $238,000,000 authorized for the year 1939 before Jan. 1, 1938, the date on which the Secretary of Agriculture is required to announce allocations of the authorized funds among the states. His plan appears to call for reducing the 1939 authorizations to $100,000,000. For the year 1940 and the next few years he would limit authorizations to $125,000,000.

The procedure in granting federal aid is peculiar. In other matters a Con-

(*continued on page 882*)

Hydro Electric Power Found Cheaper

President sends Congress report denying economy of steam as compared with hydro power

"Widespread propaganda" by utility interests, and particularly the Committee of Public Utility Executives to the effect that federal hydro-electric developments are more expensive than equivalent modern steam plants is attacked in a report prepared by the New York State Power Authority and transmitted to Congress by President Roosevelt Nov. 23.

The figures on the relative economy of steam were given currency, the report said, in a paper read by F. F. Fowle, former consulting engineer for the National Electric Light Association, before the Midwest Power Engineering Conference. Mr. Fowle's figures, which indicated that steam was much cheaper than federal hydro-electric power, were used by A. A. Potter, dean of the Purdue School of Engineering in writing the section on power in the National Resources Committee's report on Technological Trends "thus creating the appearance of government recognition of these figures."

On the basis of its own study, the power authority concludes that federal electric power is definitely cheaper than steam. Thus where Mr. Fowle uses a cost of 4.0 mills per kw.-hr. for generation of electricity by steam at the mouth of the mine, the report estimates 5.2 mills, and where Mr. Fowle finds 6.3 mills as the cost of government hydro-electric generation, the report finds 2.1 mills. Estimates of transmission costs are similarly changed. The report estimates the cost of electricity at load centers, including cost of transmission, at the Bonneville, Grand Coulee and Boulder Dam, at 3.5, 3.1 and 3.4 mills per kw.-hr. respectively. Cost of generation at equivalent steam plants, the report says, would be 6.5, 6.5 and 6.4; the total annual saving over steam generation from the construction of these three plants would amount to $50,000,000 per year.

Criticizing Mr. Fowle's paper, the report claims that he failed to make any allowance for reserve capacity of steam plants which, according to the authority, must be set at 25 per cent.

In his estimate of hydro-electric cost, the authority says, Mr. Fowle used the total cost of government dams, including such items as the canal at Boulder Dam and the irrigation ditches at Grand Coulee. Mr. Fowle's estimate of the ratio of dependable power capacity to total power installation was called too low, and the authority attacks Mr. Fowle's assumption that government projects should fix their rates on the basis of the same return on fixed charges as that expected by private utilities.

NEW TRAFFIC ROUTE UNDER THE HUDSON RIVER

FIRST of two tubes of the Lincoln Tunnel under the Hudson River between New York City and Weehawken, N. J., will be opened to traffic on Dec. 22. For the next three years until the second adjoining tube is completed the first tunnel will carry traffic both ways. This view shows a finished section near the New York portal. Glass tile on the ceiling slab and brick paving are new interior finish features. The subaqueous section of the tunnel was driven by Mason & Hanger Co., Inc., for the Port of New York Authority.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY *ENGINEERING NEWS-RECORD*, IN NOVEMBER, 1937

Engineering News-Record *reports projects of the following minimum cost: Water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

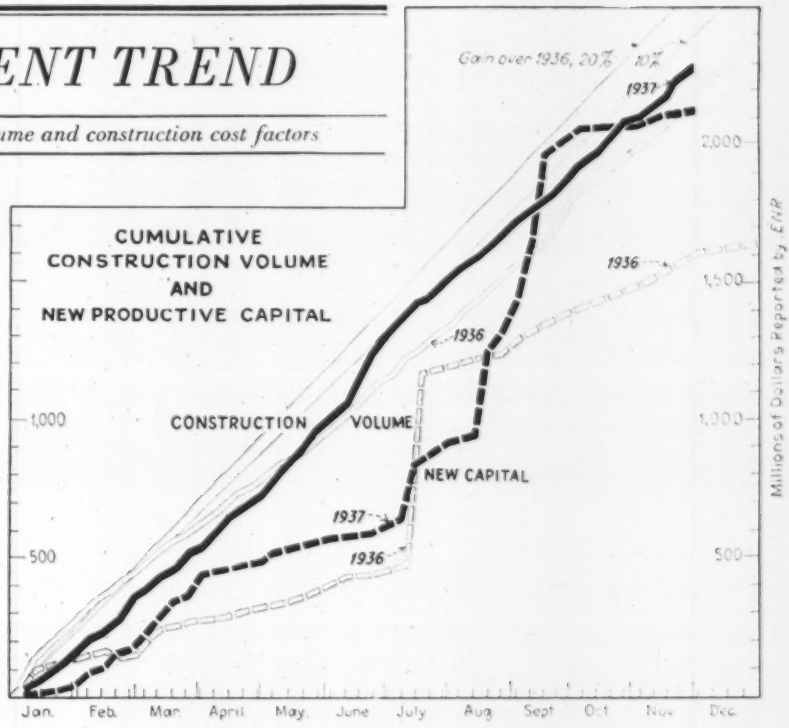
Four Weeks — Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States November 1937	United States Eleven Months 1937	United States Eleven Months 1936	Canada
Waterworks	55	34,533	134	519	1,467	808	**37,516**	96,695	85,378	
Sewerage	117	4,661	343	3,235	589	207	**9,152**	88,838	113,144	.....
Bridges	1,446	2,136	863	1,121	2,161	1,185	**8,912**	115,570	157,271	107
Earthwork and waterways	32	778	153	255	1,158	1,093	**3,469**	94,095	164,929	119
Streets and roads	619	5,070	5,329	7,189	4,953	3,478	**26,638**	380,652	450,906	617
Buildings, public	274	11,603	2,261	1,185	3,738	1,586	**20,647**	287,719	410,061	7,337
Unclassified, public	140	3,907	190	451	365	960	**6,013**	126,844	113,847	177
Total public	**2,683**	**62,688**	**9,273**	**13,955**	**14,431**	**9,317**	**112,347**	**1,190,413**	**1,495,536**	**8,380**
Federal government (included in above classifications)	**74**	**1,146**	**1,515**	**461**	**1,597**	**1,919**	**6,712**	**181,568**	**295,693**	.....
Private										
Bridges, private	.....	614	.....	.....	.....	100	**714**	7,859	11,714	.....
Buildings, industrial	1,020	4,730	595	5,655	2,495	635	**15,130**	463,035	259,847	767
Buildings, commercial	1,646	18,337	1,100	2,328	1,102	2,650	**27,163**	425,503	246,495	400
Unclassified, private	72	1,221	1,472	4,419	1,693	1,350	**10,227**	151,780	106,952	232
Total private	**2,738**	**24,902**	**3,167**	**12,402**	**5,290**	**4,735**	**53,234**	**1,048,177**	**625,008**	**1,399**
Total Engineering Construction										
November, 1937 (4 weeks)	**5,421**	**87,590**	**12,440**	**26,357**	**19,721**	**14,052**	**165,581**	.....	.....	**9,779**
October, 1937 (4 weeks)	7,867	73,783*	20,314	45,102	25,083	14,852	**187,001***	.....	.....	12,771
November, 1936 (4 weeks)	5,451	65,369	18,223	27,247	24,970	21,484	**162,743**	.....	.....	10,796
Eleven months, 1937	103,345	991,337	219,504	385,993	318,795	219,616	.....	2,238,590	.....	.....
Eleven months, 1936	131,387	705,085	273,513	359,306	391,828	259,425	.....	.....	2,120,544	892.67

*Revised

THE CURRENT TREND

This week's news of contract volume and construction cost factors



THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending Dec. 3 1936	Nov. 25 1937	Dec. 2 1937
Federal	$6,325	$977	$3,675
State & Municipal	29,486	51,624	21,347
Total public	$35,811	$52,601	$25,022
Total private	38,517	19,880	16,658
TOTALS	$74,328	$72,481	$41,680

Cumulative
1937 (48 weeks) $2,280,270
1936 (49 weeks) $2,194,872

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative, 1936 49 Wks.	1937 48 Wks.
NON-FEDERAL	$921,309	$1,369,750
State & mun. bonds	484,110	461,734
Corporate securities	243,502	499,951
PWA loans, grants	168,699	178,126
RFC loans	24,998	29,939
Fed. aid for highways	.....	200,000
FEDERAL	$691,237	$746,223
TOTAL CAPITAL	$1,612,546	$2,115,973

ENR INDEX NUMBERS

COST Base=100	1913	1926	VOLUME	1913	1926
Dec., 1937	244.95	117.75*	Nov., 1937	146	64
Nov., 1937	244.95	117.75	Oct., 1937	167	73
Dec., 1936	220.05	105.78	Nov., 1936	159	70
1937 (Av.)	236.41	113.63	1936 (Av.)	185	81
1936 (Av.)	206.46	99.24	1935 (Av.)	135	58
1935 (Av.)	195.22	93.84	1934 (Av.)	114	50

Business Briefs

EMPLOYMENT IN THE PRODUCTION of six major construction materials, based on 1923-1925=100, is 60.8 for October, as reported by the PWA Projects Division. This is a 3.5 per cent decrease from September, but a 2 per cent increase over October, 1936.

TERRA COTTA ORDERS for the 10 months of 1937 totalled 13,576 short tons compared with 13,686 in 1936, according to the Bureau of the Census. Value of 1937 orders reached $1,508,479, compared with $1,623,696 for the 10 months of 1936.

EMPLOYMENT IN THE PRIVATE building construction industry during October declined 3.3 per cent from September, and payrolls dropped 2.8 per cent as reported by the Bureau of Labor Statistics. Employment and payrolls increased 0.4 per cent and 14.2 per cent, respectively, over October 1936. Reports are from 9,064 contractors employing 110,251 men engaged in erecting, altering and repairing private building.

THE MONTH'S SCOREBOARD

CONSTRUCTION VOLUME

(,000 omitted)	November 1936	1937	% Change	Eleven months 1936	1937	% Change
Total	$162,743	$165,581	+2	$2,120,544	$2,238,590	+8
Private	59,462	53,234	−10	625,008	1,048,177	+71
Public	103,281	112,347	+9	1,495,536	1,190,413	−19
Federal	20,177	6,712	−67	295,693	181,568	−37

NEW PRODUCTIVE CAPITAL

(,000 omitted)						
Total	$109,168	$36,840	−66	$1,583,875	$2,110,362	+36
Private Investment	79,386	36,840	−54	713,767	956,074	+37
Federal (non-fed. wk.)	29,782	.....	.....	178,871	408,065	+128
Federal (fed. wk.)	.....	.....	.....	691,237	746,223	+10

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	December 1936	1937	% Change	1936 Nov.	Dec.	% Change Nov. to Dec.	1937 Nov.	Dec.	% Change Nov. to Dec.
ENR Construction Cost Index 1913=100	220.05	244.95	+11	212.70	220.05	+4	244.95	244.95	0

ENR 20-CITIES AVERAGE

Common Labor	$.586	$.678	+16	$.583	$.586	+.5	$.678	$.678	0
Skilled Labor	1.180	1.391	+18	1.178	1.180	+.2	1.382	1.391	+.6
Bricklayers	1.228	1.480	+20	1.228	1.228	0	1.480	1.480	0
Struct. Ironworkers	1.234	1.435	+16	1.228	1.234	+.5	1.425	1.435	+.7
Carpenters	1.079	1.257	+17	1.077	1.079	+.2	1.242	1.257	+1.2
Cement, per bbl	$2.59	$2.53	−2	$2.59	$2.59	0	$2.53	$2.53	0
Reinforcing, Steel new billet	2.67	2.91	+9	2.67	2.67	0	2.91	2.91	0
Struct. Steel, Pittsburgh	1.90	2.25	+19	1.90	1.90	0	2.25	2.25	0
Sand, per ton	1.18	1.23	+4	1.18	1.18	0	1.22	1.23	+.8
Lumber 2x4 Fir, per M	33.23	36.02	+8	33.06	33.23	+.5	36.09	36.02	−.2
Lumber 2x4 Pine, per M	30.49	31.35	+3	30.93	30.49	−1.4	31.88	31.35	−1.7
Brick, Common, per M	13.93	14.11	+1	13.90	13.93	+.2	14.12	14.11	−.1
Ready-mixed Concrete	7.16	7.42	+4	7.16	7.16	0	7.42	7.42	0
Struct. Clay Tile 3x12x12	72.65	72.89	+.3	72.65	72.65	0	72.95	72.89	−.1
Paving Asphalt, cars, ton	16.93	16.99	+.4	16.90	16.93	+.2	17.15	16.99	−1.0

MATERIAL SHIPMENTS . . . BUILDING PERMITS

	November 1936	1937	% Change	Oct. 1937	Change Oct.-Nov.
Lumber (% 1929 wk. av.) N.L.M.A.	62	54	−13	63	−14
Steel A.I.S.I. (% operating capacity)	74.3	39.3	−47	59.4	−34

	October 1936	1937	% Change	Ten Months 1936	1937	% Change
Fabricated Struct. Steel* A. I. S. C	156,717	149,308	−5	1,292,315	1,415,403	+9
Dun & Bradstreet (,000 omitted)	$90,702	$90,675	0	$821,433	$942,293	+14.7

*Subject to revision

RENT INDEX

	October 1936	1937	% Change	Sept. 1937	Change Sept.-Oct.
Rent (housing) Index, N.I.C.B.	80.8	89.2	+10	88.6	+.7

San Jacinto Work Near Normal

Water district states work is proceeding faster than before strike was called

With construction crews back to normal, work on the San Jacinto tunnel of the Metropolitan Water District was proceeding at a rate of 37 ft. per day during the first half of November. This is an increase of 16 ft. per day over the daily average maintained prior to Aug. 14, when a strike was called by the Tunnel, Subway and Aqueduct Workers Union, Local 270 of the International Union of Mine, Mill and Smelter Workers, C.I.O., according to an announcement from the Metropolitan Water District.

About 3½ miles remain to be excavated in the tunnel, which is being driven from the Potrero and Cabazon shafts. The San Jacinto tunnel will be the last of 38 tunnels in the project to be completed.

History of strike

The strike was called Aug. 14 following the refusal of the board of directors of the Metropolitan Water District to sign an agreement recognizing the union as sole bargaining agency for all employees on the tunnel.

At the time the strike was called, 984 men walked off the job and 206 men remained, according to figures furnished by the water district. The district kept the job open and set about replacing the strikers with other tunnel workers. The working crews were reorganized on a normal basis within a period of about three weeks. Of the men who went on strike, between 200 and 300 have been reemployed on the tunnel.

Union statement

A statement made to *Engineering News-Record* by C. H. Jordan, secretary of the Los Angeles Industrial Union Council, C.I.O., states that the strike was brought on by "a continuous campaign of discrimination" against the union, including discharge of officers, committeemen, and other active members. When negotiations to secure reinstatement of discharged men and an agreement to eliminate recurrences of discrimination were unsuccessful, the strike was voted by a majority of 89 per cent and called Aug. 14. The board of directors of the district, according to Mr. Jordan's statement, refused the request of the union negotiations committee to appoint a committee from their body to discuss ways and means of settling the strike. Charges were brought before the National Labor Relations Board, but the NLRB refused to accept jurisdiction over district affairs.

The strike was characterized by Mr. Jordan as having involved "numerous acts of brutality against strikers on and off the picket lines. Several men were shot and at Cabazon the pickets were tear-gased and clubed . . . over 100 strikers were arrested. . . . Practically all the strikers brought to trial were exonerated of any charges."

. . .

Final Traction Report Submitted at Chicago

When the preliminary report on a coordinated transit system for Chicago was submitted Oct. 19. (*ENR* Oct. 28, p. 694) it was stated that the engineers desired a month to refine it. The final report was completed and presented by Mayor E. J. Kelly to the local transportation committee of the city council and to the U. S. District Court on Nov. 22. To convert the plan into reality, the city council must approve it and draft an ordinance authorizing an operating company to construct and operate the comprehensive system and the voters must approve the ordinance.

The engineers who developed the report, a 400-pp. mimeographed volume, are soon to give the aldermen on the transportation committee several lectures on the plan.

The final report raised the estimated cost of the city's portion of the plan some $4,000,000 to $62,180,000; the companies' share is $98,728,100 as formerly. The consolidated annual income at present, it is stated, would be $4,000,000 but could be increased to $14,000,000 within 10 years. This is sufficient to pay the city an adequate compensation and give the companies a reasonable return on all securities representing a fair valuation.

As an answer to the many criticisms received from West Side organizations of the proposal to make superhighways out of the elevated lines on the West Side the report quotes the engineers as saying "that the locations of the highways are in harmony with sound planning for the present and future traffic needs of the city. They do not contend that these transit highways are the complete answer to all traffic requirements." Many of these organizations want Congress St. considered as the major thoroughfare to be improved and they feel that gas tax and other monies, if used for conversion of the elevated structure for motor traffic, will leave the Congress St. project without possible funds for years.

Mayor Kelly in submitting the report indicated that no additional enabling legislation was necessary.

Building Stimulation

(continued from page 877)

$6,000, it is proposed to amend the National Housing Act to raise the size of the mortgage which may be insured from 80 to 90 per cent of the appraised value. This represents a 50 per cent reduction in the down payment to be made by the buyer.

The Housing Administrator will be authorized to reduce the mortgage insurance premium on this class of building to one-quarter of one per cent on the diminishing balance, making the total financing charge 5¼ per cent. This is a reduction of 1 per cent as compared with the present charge.

On other types of property the present overall financing cost of 6¼ per cent is to be reduced to 5½ per cent.

Small apartments

Mortgages will be insured, under the proposed legislation, up to a value of $200,000 on houses or apartments built for sale or rent, provided that the mortgage does not exceed $1,000 per room. The law as it now stands makes no provision for insuring mortgages on buildings lying in the class between those costing less than $16,000 and the large-scale developments that may be undertaken by the rigidly controlled limited dividend companies. Under the proposed law, mortgages up to $200,000 could be insured without being subject to limited dividend restrictions. It is expected that many walk-up apartments and smaller subdivisions can be built under these terms.

Large apartments

In larger apartment houses where elevators must be provided and more fireproofing done, the plan calls for a $5,000,000 limit on cost, of which 80 per cent would be insurable. The amount of dividends that could be paid would be regulated as long as the mortgage was insured.

The $5,000,000 allowed could also be used for construction of detached houses.

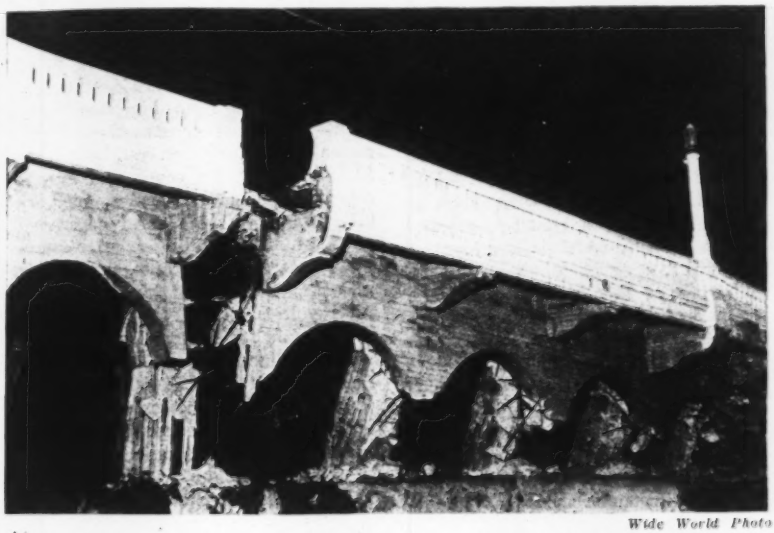
Mortgage associations

In order to facilitate the financing of very large projects, the President recommends liberalizing the provisions of the act under which chartering of national mortgage associations is authorized. These associations would be given express authority to make loans on large scale properties which are subject to special regulation by the Federal Housing Administrator.

The mortgage associations would be authorized to sell debentures up to twenty times their capitalization. The debentures would be legal investments

Wide World Photo

TWO BREAKS in the face of Elysian Park hill are shown in this air view. The slide first gave way at the bottom, and then the upper part of the hill dropped 50 ft. A high voltage steel tower, brought down by the slide, can be faintly seen at the top of the lower break in the center of the picture.



Wide World Photo

A VIADUCT below the Elysian Park hill was wrecked by the landslide.

for saving banks, insurance companies and similar institutions. A "demonstration" association is to be financed with $50,000,000 of RFC funds. By the sale of debentures this association would be able to finance $1,000,000 of housing.

Competition among mortgage associations is expected to reduce the cost of large loans to 5 per cent, including servicing and insurance costs.

Repair and modernization

One of the most successful features of the housing act of 1934 was its provision for insurance of loans for repair and modernization of existing buildings. Authority to make these loans expired last April. It is planned to revive that provision. However loans would be limited to $10,000 instead of $50,000 and loans could not be made on installation of equipment as under the old law.

It is also proposed to remove the time limit fixed for the 1934 law at July 1, 1939. No change is proposed in the $2,000,000,000 limit on the amount of mortgages that may be insured under the entire program.

Hillside Lets Go In Los Angeles

Slipping hill in Elysian Park drops million yards of earth on road below

A concrete viaduct approach to the Dayton Ave. bridge in Los Angeles was destroyed and Riverside Drive was blocked for a distance of 350 ft. when a 6-acre cliff face in Elysian Park slid down onto the road below.

A gradual movement of the cliff face began on Oct. 29 increasing to a rate of an inch or more a day (*ENR*, Nov. 25, 1937, p. 842) until Nov. 26, when nearly a million cubic yards of earth and rock dropped onto the road. At the top of the hill the slide area dropped a total of 60 ft.

Building undamaged

City officials withheld damage figures until a decision could be reached on whether Riverside Drive should be rerouted or cleared of debris. Only a few privately owned buildings stand near the foot of the slide, and these were undamaged. About 140 ft. of an old water distribution tunnel was broken out.

Temporary mains have been installed to replace the 24-in. line which was broken in the earlier, slow, stages of the landslide, as noted in last week's issue.

Reservoir drained

The Elysian Park reservoir above the area was drained on orders of W. W. Hurlbut, executive engineer of the city water department. Electric power transmission lines of the Southern California Edison Company and Los Angeles Bureau of Power and Light crossing the area have been rerouted.

Causes of slide

The possibility that the slippage was started by leakage from the Elysian Park reservoir was reported unfounded after inspection of the reservoir when it had been drained. The theory also has been advanced that the soil has been loosened by seepage of water used for irrigation in the park. City authorities retained Dr. John P. Buwalda, professor of geology at the California Institute of Technology and Raymond A. Hill, Los Angeles geologist, to endeavor to determine the causes of the slippage. Dr. Buwalda reported that erosion caused by the river, slicing off of the hill to permit construction of Riverside Dr., heavy traffic, and rain seepage were contributing factors to the movement. Further sliding is to be expected, he said.

LABOR NOTES

ABOUT a thousand engineering and clerical employees of the Minnesota highway department who have been organized as Local 71 of the International Federation of Technical Engineers, Architects and Draftsmen's Union, A.F.L., of St. Paul, have transferred to the C.I.O. They are now members of Chapter 30 of the Federation of Architects, Engineers, Chemists and Technicians, C.I.O. Organization of the Minnesota highway department started in 1935 with the formation of an independent union by a group of engineers in the planning department. Organization was on an industrial basis, including all classifications employed in the central office. The organization thus covers the entire state, because engineers on construction projects are subject to transfer. Due in part to the presence in power of the Farmer-Labor party in Minnesota, this organization was quite successful in negotiations with the highway department.

Last June, when a chapter of the State, County and Municipal Employees, A.F.L., was formed in St. Paul, the highway department group affiliated with the I.F.T.E.A.D.U. Dissatisfaction with their experience in that body has led to the present shift in affiliation.

ANOTHER boost for the F.A.E.C.T. came when the Harris Structural Steel Co. of New York City agreed to reinstate Arthur Levin, who was discharged June 9 after having been with the firm since 1923. He had taken an active and leading part in organizing draftsmen at the Harris Co. The agreement to reinstate Mr. Levin came as an out-of-court settlement of a National Labor Relation's Board complaint brought by the F.A.E.C.T. and terminated hearings which were being held on the case Nov. 15 and 16.

DISSATISFACTION with the wage scales established as prevailing at Grand Coulee Dam by the Department of Labor and included in the specifications for the high-dam contract, has been expressed by the Building and Construction Trades section of the Washington State Federation of Labor. The secretary of the section has asked the government to postpone opening of bids on the high dam, which has been set for Dec. 10. It is stated that the wage scale is below that prevailing in the state and does not conform to evidence submitted to a referee at hearings held at the dam site. The state federation has proposed a minimum of $.75 for common labor and $1.50 for skilled, rather than the $.60 and $1.20 minima set by the Department of Labor.

Meanwhile A. F. L. unions at the dam project announced that they will try to gain higher wage schedules than those set in the specifications through negotiations with prospective bidders.

• • •

Technicians Held a Unit In Bargaining

Technical engineers and draftsmen employed at the West Allis, Wis. plant of the Allis-Chalmers Mfg. Co. were held to be a separate bargaining unit in a National Labor Relations Board decision handed down Nov. 22. The N.L.R.B. decision ordered that an election be held within 30 days among the 10,000 workers. Production workers will vote whether or not they wish to be represented by Local 248 of United Automobile Workers of America, C.I.O.

Technical workers will vote whether they wish to be represented by Local 248 or by the Independent Engineers' and Draftsmen's Association, a body with no outside affiliations. They will remain a separate unit regardless of their choice of bargaining agent.

Two other groups will hold separate elections. The electricians and the boiler house employees will each vote separately whether they wish to be represented by Local 248 or by A.F.L. craft unions.

Local 248 holds a contract, granted to it last May, by which it is recognized as bargaining agent for its members, numbering at that time about 7,000. The Independent Engineers and Draftsmen's Association holds a similar contract, granted at the same time, as do the firemen and oilers.

A dissenting minority opinion disagrees with the finding that the boiler crew and electrical group may vote separately, but agrees that the engineers and draftsmen should have separate representation.

• • •

Tri-County Offers to Buy Power Company

Directors of the Central Nebraska (Tri-County) Public Power and Irrigation District decided Nov. 26 to offer to buy the property of the Western Public Service Co. of Scottsbluff. The board also authorized offers to purchase the Southern Nebraska Power Co.

This action of the directors is viewed as the first step in the proposed plan by which interlinked Nebraska power districts would purchase all power companies in the state.

Cut Federal Aid

(continued from 877)

gressional authorization is no more than an expression of a good intention; an appropriation must follow before the money can be obligated. Paving roads in the United States, however, requires more than good intentions, so the federal-aid law authorizes not only a future appropriation, but also the immediate obligation of the sum authorized. The actual disbursement, of course, can not be made until later. The President does not like this procedure; it ties his hands for too far in the future. He would prefer the usual method of appropriating first and spending later.

Opposition developes

Strong opposition to the proposals of the President was expressed in Congress immediately following the reading of his message. Both Senator Hayden and Representative Cartwright, authors of highway legislation, expressed the view that the President's recommendation if put into effect, would cause Congress to break faith with the states.

What a cut in federal aid will mean to next year's highway construction volume can be inferred from figures for the calendar year 1936—the latest available. The state highway departments spent, on construction, maintenance, and bond interest, a total of $1,131,151,000. To cover this they received, from state revenues, $669,474,000, and from the federal government $346,281,000, including regular federal aid, emergency grants, and other miscellaneous federal payments such as oil royalties.

The state funds were largely derived from gasoline taxes ($434,876,000) and license fees ($219,088,000). As for the federal funds, they came from the general funds of the Treasury, since excise taxes are not earmarked. But it is significant that during the fiscal year 1937 the United States collected from taxes on gasoline, lurbicating oils, tires and tubes, automobile and motorcycle sales, and parts and accessories the grand total of $353,196,602.

Mr. Roosevelt's message does not advocate the repeal of these special vehicle taxes.

• • •

New Bridge Planned At Niagara

A Canadian company has made application to the federal Parliament for permission to incorporate the Niagara Falls Observation Bridge Co. The company plans a new bridge across the Niagara River between Niagara Falls, Ont. and Niagara Falls, N. Y.

Reduction In Federal Aid

Text of President Roosevelt's message on curtailment of federal aid to highways sent to Congress Nov. 30

BY THE ACT of June 16, 1936, the Congress authorized appropriations totalling $216,500,000 for each of the fiscal years 1938 and 1939, for federal-aid highways, secondary or feeder roads, elimination of gradecrossings, forest highways, roads and trails, and highways across public lands, to be administered by the Department of Agriculture. This act also authorized appropriations totalling $21,500,000 for each of the fiscal years 1938 and 1939, for roads and trails within national parks, for parkways to give access to national parks and form connecting sections of a national parkway plan, and for Indian reservation roads, to be administered by the Department of the Interior.

$38,000,000 Appropriated

Under the first category there has been appropriated to date on account of the authorizations for the fiscal year 1938, a total of $24,500,000 and under the second category a total of $13,500,000, or a grand total of $38,000,000, leaving $200,000,000 still to be appropriated for that fiscal year (1938). To meet obligations under this $200,000,000 of outstanding authorizations, I propose to include an estimate of appropriation of approximately $100,000,000 in the budget for the fiscal year 1939, with the balance to be provided for 1940.

This takes care of the authorizations for the fiscal year 1938 and leaves for consideration the authorizations of $238,000,000 for the fiscal year 1939.

In view of the large amounts which have been contributed by the federal government, particularly during the past five years, for the construction of public roads, and because of the necessity for taking definite steps to reduce expenditures for the purpose of securing a balanced budget, I recommend that Congress adopt the following policies:

Cancel authorization

1. Provide for the cancellation of the 1939 authorization prior to Jan. 1, 1938, by which date the Secretary of Agriculture is required to apportion to the various states $214,000,000 of such authorization.

2. Limit to not more than $125,000,000 per annum all public roads authorizations for the fiscal year 1940, and for each of the next few succeeding years.

Since the enactment of the first federal-aid highway act in 1916, there has been appropriated for public highways, including allotments from emergency appropriations, more than $3,100,000,000 of which amount $1,490,000,000 has been made available during the last five years. This annual average for the past five years of $298,000,000 contrasts with an annual average of less than $100,000,000 for the five year period preceding the depression.

Appropriation procedure

There is another provision of the existing law relating to public roads which should receive consideration in this connection. The secretary of Agriculture is required to apportion to the states the annual amount authorized for appropriation and to approve projects and proposed state exenditures thereunder which shall constitute contractual obligations of the federal government regardless of the availability of appropriations for their payment and of the fiscal outlook of the treasury.

Mandatory obligation

This mandatory provision completely ties the hands of the executive as to the amount of road funds to be included in the budget for any fiscal year. While I do not object to the apportionment among the states of such amounts as may be authorized for appropriation, I do most strenuously object to the mandatory incurrence of obligations by the federal government under such apportionments without regard to its ability to finance them from its revenues. I, therefore, recommend that the Congress take the necessary action permanently to eliminate this provision of our public roads law.

• • •

C. R. Hulsart Dies

C. Raymond Hulsart, vice president of the Atlas Lumnite Cement Co., New York, died in the New Rochelle hospital on Nov. 30 from heart trouble. Mr. Hulsart was 54 years old. His death occurred on the 20th anniversary of his participation in the Cambrai battle in France where his gallantry in action brought him both the American Distinguished Service Cross and the British Military Cross. At the time he was a captain in command of Company B, 11th Engineers, engaged in the reconstruction of standard-gage railway tracks on the British front.

Mr. Hulsart was born in Seabright, N. J. and graduated from New York University in 1905. Shortly thereafter he joined the engineering force then engaged in developing the Catskill water supply for New York City, ultimately becoming an assistant engineer in charge of Sec. 4 of the Walkill Division.

Since the World War Mr. Hulsart has devoted most of his time to cement manufacture, first as engineer for the Cement Manufacturers Protective Assn., and then as vice president of the Atlas Lumnite Cement Co. for the past 16 years.

• • •

Coast Survey Director Dies at 54

Rear Admiral Raymond F. Patton, for the past eight years director of the Coast and Geodetic Survey, died in Washington, D. C., Nov. 25. He was fifty-four years old.

Admiral Patton entered the Coast and Geodetic Survey service in 1904, immediately after his graduation from Western Reserve University. After some years before as an aide in surveys on the Atlantic, Alaskan and Philippine coasts, he became executive officer on surveys of western Alaska and of the Pacific approaches to Panama Canal. A few months later he took command of the U.S.S. Explorer on similar surveys, and in 1915 he was made chief of the coast pilot section of the Survey. Two years later he was put in charge of purchase and supply of navigational instruments to the fleet with the rank of lieutenant commander, U.S.N.R.F. In 1919 he became chief of the division of charts of the U. S. Coast and Geodetic Service, holding that position until he became director of the Survey in 1929.

• • •

New Road Finance Plan For Texas County

A "pay-as-you-go" method of road construction in Harris county, Texas, is provided for by an enabling act just signed by Governor Allret which carries out the provisions of a recently adopted state constitutional amendment.

Under the provisions of the new financing plan, county commissioners may draw up a highway improvement plan, submit it to the voters with a special tax measure to provide the necessary funds, and let the public pass on the entire proposal. The construction program would then be carried out from year to year as tax funds accrue through annual collections.

News Continued on page 910

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Engineering as a Profession

Sir: More power to Mr. Chevalier for his splendid presentation of the above topic in the current issue of *Engineering News-Record*! A few articles like that are worth a million frothy pronouncements by professors and worthless engineering societies to the contrary. Just as soon as the rank and file engineer (and by that I mean the employee-engineer) gets it into his skull that all this talk of "professionhood" is so much nonsense, the better off he will be and the quicker he will be to note that there may be something to unionization after all. Engineering societies are powerless to improve salaries. Can you imagine employer-engineer dominated societies moving for salary increases? It is not in the cards! The employer-engineer will always attempt to secure the best talent at the lowest salary, but at society meetings and dinners he will prate of elevating engineering to a par with medicine and the law. Our rank and file engineer friends are hopelessly deluded into believing that they are professional men when the vast majority of them are nothing more than a species of skilled help *to be bought at the market price.*

WILLIAM STACK
Registered Civil Engineer
Chicago, Ill., Nov. 23, 1937

Professional Problems

Sir: Having heard of Col. Chevalier's talk before the N.C.S.B.E.E., I wish to thank you for making it available in its entirety. Two points might bear comment and, possibly, further discussion.

I wonder when we shall let medicine and law alone as a basis of comparison or a model of professionalism. I am not convinced they are the latter, and for reasons mentioned by Col. Chevalier they should not be used for the former. Why not use the same engineering approach to our problems and in their solution that we would use on any engineering problem. Would we design a bridge just like another when foundation conditions were different?

Col. Chevalier mentions the engineer-employer who feels in justice to his client he must hire engineering assistants as cheaply as possible. This is the crux of most of our troubles. I believe the truly professional engineer will sell his client on the value of good engineering assistants on adequate pay, just as he sells the economy of good materials for the job. In fact the consulting engineer of high reputation is the *only* one who can hope to sell the public on the value of engineering service. If he has no more respect for his employees than to hire them on a bargain basis what can we expect from others? Many employer-engineers seem to miss the fact that income is relative, and that the higher they can boost their employees' salaries, the higher theirs must go to stay in line.

L. W. MAHONE
Assistant Professor, Iowa State College,
Ames, Iowa, Nov. 23, 1937.

Concrete Mixer Design

Sir: The discussion by Lewis H. Tuthill in the issues of the *Engineering News-Record* of Aug. 5 and Nov. 4, 1937, relating to the design of concrete mixers should have considerable value in drawing attention again to one of the important elements of the production of concrete of uniform quality. The matter is treated, however, only from the viewpoint of achieving a homogeneous mixture. Improvement in the design of mixers is also needed to insure more complete utilization of the cement; that is, there should be a mixing action that wets more of the cement particles, producing more of the cement jell in a given time.

Our experience does not agree with Mr. Tuthill's in regard to double-cone tilting mixers, possibly due to difference in equipment or operation.

It is taken for granted in the discussions that the mixers are kept properly maintained. We find on the average job that the usual trouble is that blades are badly worn or appreciable accumulations of hardened concrete have built up on the blades and in the buckets. Such mixers in proper condition do a good job of producing homogeneous concrete but in the condition described can and do make only segregated concrete. When consideration is given to the design of mixers, more attention should be given to the elimination as far as possible of the building up of pockets of concrete hard to remove and also to facilitate replacement of worn blades.

Mixers are also frequently observed which are overloaded and here again only segregated concrete can be produced. The rating given by the manufacturer of the mixer is normally satisfactory and we find it may safely be followed.

MILES N. CLAIR
Vice President,
The Thompson & Lichtner Co. Inc.,
Boston, Mass., Nov. 15, 1937.

How Stiff Is a Beam?

Sir: I should like to offer the following solution of your "How Stiff is a Beam?" problem in the September 23 issue.

Maximum deflection, at center, of the fixed beam, with single load at center:

$$y_1 = \frac{P\,l^3}{192\,E\,I}$$

Maximum deflection, at center, of the fixed beam, with uniformly distributed load:

$$y_2 = \frac{W\,l^3}{384\,E\,I}$$

Maximum maximorum deflection of the beam, at center:

$$Y = y_1 + y_2$$

$$Y = \frac{P\,l^3}{192\,E\,I} + \frac{W\,l^3}{384\,E\,I}$$

$$= \frac{l^3}{192\,E\,I}\left(P + \frac{W}{2}\right) \qquad (1)$$

Modulus of elasticity of structural steel is assumed:

$$E_s = 29{,}000{,}000 \text{ lb. in.}^2$$

Modulus of elasticity of cast iron is assumed:

$$E_c = 15{,}000{,}000 \text{ lb. in.}^2$$

Weight of the steel per cubic foot in pounds $w_s = 490$

Weight of the cast iron per cubic foot in pounds $w_c = 450$

Conditions shown by the sketch of the problem: Section of the beam $b = 2$ in., $d = \frac{1}{2}$ in.; $I = 40$ in. and $P = 500$ lb.

Deflection of beam equation (1):

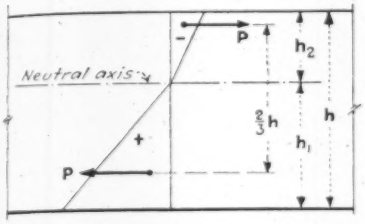
$$\text{Steel } Y = \frac{40^3}{192\times29{,}000{,}000\times\frac{1}{12}\times2(\frac{1}{2})^3}\left(500+\frac{2\times\frac{1}{2}\times40\times490}{12\times12\times12\times2}\right)=0.28 \text{ in.}$$

$$\text{Cast iron } Y = \frac{40^3}{192\times15{,}000{,}000\times\frac{1}{12}\times2(\frac{1}{2})^3}\left(500\times\frac{2\times\frac{1}{2}\times40\times450}{12\times12\times12\times2}\right)=0.54 \text{ in.}$$

Conclusion: The steel beam is stiffer.

G. P. TORRES

S. Paulo, Brazil, Oct. 13, 1937.



Sir: In several solutions of your beam stiffness problem I see that no mention is made of the fundamental governing the problem, which is the location of the respective neutral axes. In steel it would be at the center, therefore $I = .0208$. Because of different values of tension and compressive strengths of cast iron it moves near the top as shown. In solving the problem I assumed that the load should be 50 lb., otherwise if 500 lb. is used no comparison can be made, as the elastic limits are exceeded.

For locating the neutral axis of Cast Iron section:

E_1 = in tension = 12,000,000

E_2 = in comp. = 29,000,000

r = radius curvature of deflection curve.

$$f_{tens} \text{ or } f_{comp} = +\frac{E_1 h_1}{r} = -\frac{E_2 h_2}{r} \quad (1)$$

(fundamental)

$$P = +\frac{f_{\text{tenston}}\, bh_1}{2} = -\frac{f_{comp}\, bh_2}{2} \quad (2)$$

$\frac{E_1 h_1}{r}\frac{bh_1}{2} = \frac{E_2 h_2}{r}\frac{bh_2}{2}$, sub f_t and f_c from (1)

$$E_1 h_1^2 = E_2 h_2^2$$

$$h = .5$$

$$\sqrt{E_1} = 3460$$

$$\sqrt{E_2} = 5390$$

$$\therefore h_1 = \frac{h\sqrt{E_2}}{\sqrt{E_1}+\sqrt{E_2}} = \frac{.5\times5390}{8850} = .325 \text{ in.}$$

$$h_2 = \frac{h\sqrt{E_1}}{\sqrt{E_1}+\sqrt{E_2}} = \frac{.5\times3460}{8850} = .175 \text{ in.}$$

By transforming I about center of section to .175 in. below top, the I about $NA = .0264$ in.

∴ Solution (50-lb. load) neglecting dead load:

$$\text{Cast Iron } d = \frac{50\times40^3}{192\times12{,}000{,}000\times.0264} = .0527 \text{ in.}$$

$$\text{Steel } d = \frac{50\times40^3}{192\times29{,}000{,}000\times.0208} = 0.0276 \text{ in.}$$

∴ Cast iron deflects twice as much.

R. GROSSMAN

Division of design, eng. dept. San Francisco, Oct. 26, 1937.

Sir: Referring to the interesting problem in the issue of Sept. 23, p. 525, I wish to give the following solution:

The deflection of a beam restrained both ends and with a single load applied in the middle is

$$d = \frac{W L^3}{192 E I} \quad (1)$$

and the maximum moment for this beam will be

$$M = \frac{W L}{8} \quad (2)$$

or

$$M = f S \quad (3)$$

By combining (2) and (3) we get

$$W L = 8 f S \quad (4)$$

so expression (1) becomes

$$d = \frac{8 f S L^2}{192 E I} \quad (5)$$

where f = the fiber stress, S = section modulus, L = span in inches, E = modulus of elasticity, and I = moment of inertia. If the height of the beam is = h, then we know that

$$\frac{S}{I} = \frac{2}{h} \quad (6)$$

Hence

$$d = \frac{8 f 2 L^2}{192 E h} = \frac{f L^2}{12 E h} \quad (7)$$

This formula is general and applies to any material. It will be noted that (h) is the only representative from the cross section, moment of inertia, and the section modulus.

From (4) it will be seen that the fiber stress is not influenced by the modulus of elasticity. *Therefore the fiber stress in this problem will be the same for both materials for the loading condition given, and is found to be 30,000 lb. per sq. in.*

The deflection is in reverse relation to the modulus of elasticity. For steel with $E = 30{,}000{,}000$, we get the deflection to be

$$d = \frac{30{,}000\times40^2}{12\times30{,}000{,}000\times0.5} = 0.266 \text{ in.}$$

and for the cast iron member with a value of $E = 15{,}000{,}000$, the corresponding deflection will be using the same formula (7) a value twice as large, or $d = 0.532$ in.

ODD ALBERT

East Orange, N. J., October 27, 1937

Mr. Tsagaris' Reply

Sir: In order to avoid any further misunderstanding on my conclusion to "How Stiff is a Beam?" in the Oct. 21 issue, I wish to make the following qualifications:

There is no question that under the *same* load the cast iron member will deflect about twice as much as the one of steel regardless of resulting fiber stress, unless one of them fails in the process, but since I limited the fiber stresses to value below the elastic limit of each material, the load that the cast iron beam can withstand is only 250 lbs. or one half of the corresponding safe load for the steel member (500 lb.), which would result in equal deflections.

Whether or not I was at liberty to use different loads for each beam, or should deal with the same load for both cases, I cannot say, perhaps the originator of the problem can tell us.

Mr. Robert Fletcher was justified in his comments appearing in the Nov. 11th issue.

DEAN P. TSAGARIS

Knoxville, Tenn., November 15, 1937

Experience with Wells In Fine Sand

In the Sept. 16 issue of *ENR* in the article on experience with wells in fine sand at the Amarillo waterworks an error appears in the center of the second column p. 472 with reference to the costs per 1,000 gal. It should read as follows: Production, 1.626c.; transmission, 0.969c.; distribution 1.030 c.; total 3.625c.

ENGINEERING NEWS-RECORD

Copyright 1937, by McGraw-Hill Publishing Company, Inc.

Volume 119, Number 23

Editor, F. E. SCHMITT · *Editorial Staff*, V. T. BOUGHTON
N. A. BOWERS, W. G. BOWMAN, W. W. DEBERARD
C. S. HILL, H. W. RICHARDSON, E. J. CLEARY

Editorial Offices at 330 West 42nd Street, New York

DECEMBER 2, 1937

THE PAST WEEK has seen the movement toward stimulating more normal construction, by removing some of the inhibitions from the electric utilities, take definite shape. Both the Consolidated Edison Co., New York, and the Niagara-Hudson Co. have advised the President that they are ready to inaugurate construction programs involving expenditures of many millions in the next three years. Thus it appears that abstract proposals may soon be taking concrete form at many points throughout the country. After all, the government's power plants, with the possible exception of the TVA, are not being built in regions where increasing demand calls for much new construction on the part of the public-utility companies. Hence their chief need at the present moment is some assurance that they will not be threatened with further expansions of that program after their commitments for new construction have been made. Some such assurance seems to have been given by the President. It remains to see what Congress will say. If its voice is more firm and explicit, a substantial amount of development is in sight.

Laid Rockfill Dams

NEW STANDARDS of precision are set by the Algerian rockfill dams described in this issue. In character these rockfills approach dry-laid rubble masonry far closer than they do the dumped fills of quarry-run rock that are common in dams of this type. In some respects the differences are so great that question arises whether the same name should be applied to both. However, as to procedure a fill built up and compacted in layers differs no more from a dumped fill of rock than does a rolled-earth embankment from a cart-dumped fill. As to purpose the difference is greater. Earth dams are built and compacted in layers primarily to secure impermeability, while prevention of slippage and settlement are at best anxiliary considerations, important chiefly because they endanger the ability of the embankment to hold water. The laid rockfill adopted by the French engineers was used primarily to avoid embankment movement that might endanger the integrity of the upstream paving as a water stop. Thus, immobility rather than impermeability of the fill is the objective, and from the tests so far made, the results sought appear to be promised. Although a saving is made in volume of fill, total costs are increased. But the development present a new type of dam structure for the consideration of engineers.

Revenue from Sludge

FOCUSING attention on by-product utilization in sewage treatment, the committee on sewage disposal of the American Public Health Association recently reported on the use of sludge as fertilizer. The report, abstracted elsewhere in this issue, is a compendium of present practice with an interpretation of the findings by a group of practical sanitarians. Emphasizing that not all types of sludge have the same fertilizing value, the committee states that heat-dried activated sludge is higher in nitrogen content and generally more useful than digested sludge, which is on a par with stable manure. A growing market is foreseen in the use of heat-dried activated sludge as a filler for commercial fertilizing mixtures. This use alone would require more than 2½ times the present amount of dry sewage sludge in the United States. These and other facts showing the close relationship between sewage disposal and agriculture lead to the conclusion that present utilization of sludge might be widely extended, with possible revenue advantages to municipalities.

Clarification Begins

RECOGNITION by the National Labor Relations Board of the peculiar position of engineering employees in a large manufacturing plant comes as a timely step in the development of administrative procedure under the Wagner Act. Engineers have expressed concern lest they be grouped with all other classes of employees, where they would always be so small a minority that no interest would be taken in their peculiar problems. Now the N.L.R.B. has defined their position in a large plant of the Allis Chalmers Manufacturing Co.; it has recognized that they should be treated separately and has authorized their own organization to represent them in collective bargaining. Whether or not the engineers of the Allis Chalmers plant vote to be represented by the U.A.W.A. local or by the Independent Engineers and Draftsmen's Union they are to remain a separate unit. One board member points out that the engineers' semi-professional interests may best be served by a different type of union than that suited to production employees. If the Labor Relations Board continues this attitude toward engineers it will eliminate one of their major problems in connection with unionization.

Economy and Roadbuilding

THE PRESIDENT'S PROPOSAL to curtail roadbuilding as a measure of national economy is unquestionably the most sensational development in national affairs in recent months.

The proposal does not mean a highway holiday. In spite of appearances, it will, if properly handled, merely operate to level down on the emergency rate of road expenditure toward a future normal. But its ultimate effect goes much farther.

Federal road contributions before the depression ranged from 75 million to 90 million dollars per year. For reemployment and recovery purposes they were greatly increased during the depression, reaching nearly 350 millions, and now stand at 200 millions per year exclusive of a few additional millions for forests and park roads. The President's proposals other than for revision of legislative practice are two: (1) to recall and wipe out the authorized road fund of 200 million dollars for the fiscal year 1938-39 before Jan. 1, in other words before the Secretary of Agriculture obligates the money to the states under the law; (2) to reduce the annual road expenditure to near the predepression figure of 80 or 90 millions. These are significant proposals. The present road appropriation system takes cognizance of the time required for the joint action of federal and state legislatures necessitated by the cost-sharing plan of road improvement. Once every two years Congress authorizes federal aid (but without making appropriations) for the following two years, this in order to give the state legislatures, which ordinarily meet only biennially, time to appropriate their share. The law requires that thereafter, on or before the first of January of each year, the Secretary of Agriculture shall announce the amount of money alloted to each state. Even though Congress has appropriated no money, the apportionment forms a binding contract with the states.

After these preliminaries, road projects are planned by the states and the plans are reviewed and approved by the Bureau of Public Roads; construction contracts are let, and as construction goes forward the federal payments are progressively made. It is because of this fact that much of the money to be spent after next July but not yet apportioned was obligated long ago.

What of roadbuilding during the coming year, if Congress should accept the President's revolutionary proposal? Briefly, it will be little changed. Expenditures to next July are covered by existing road appropriations, and commitments by existing apportionments firmly fix most of the road work for the year then beginning at a figure approaching 175 millions. Any action by Congress before January can at most reduce the 50 or 60 millions additional that would be spent during the latter half of the year.

The real import of the President's proposal is its effect on the continuing road program. Obviously, a return to normal is unavoidable if excessive spending is to come to an end. But should it be made abruptly, by cancelling a whole year's funds? And must it not take full account of urgent public needs?

Reason should rule, even in economy. The eight years since 1929 have brought a tremendous change in road travel and safety conditions. Part of this change was recognized by Congress recently in adding money for grade-crossing safety and for secondary roads; money for main roads was only moderately increased. But the earlier main roads are fast becoming obsolete. Can the predepression rate of road improvements serve as a safe standard for a road program today?

It is this question that emerges as the largest issue raised by the President's economy proposal, and it is this that warrants thorough examination and convincing discussion by highway engineers. They are aware of the widening gap between traffic needs and the service afforded by our fragmentary road system. They know what dangers and losses are caused by growing congestion, and realize that we are only at the beginning of developing a reasonably useful road network. They know, too, that an adequate road program will place no burden on the treasury, for the 350 millions of annual road taxes which the government collects will more than pay for it.

Congress is not only informed on these facts, but in shaping the future road programs it may be expected to give them careful thought. It may also recall that the public interest requires every essential public service operation to be planned for continuity, and that accordingly a road program must be planned with a long-time outlook and must be carried on in steady progress. Most of all does the nation's roadbuilding require a well-considered and stable program and a sound policy of continuing action, for roadbuilding is related to employment and business almost as intimately as to the improvement of travel.

National economy is undeniably imperative, and every government activity deserves to be scrutinized for emergency excess in order that we may resume normal ways. Even at the moment when new uncounted millions are being lavished on subsidies to farmers who have just enjoyed a prosperous crop year, reconsideration of our road program will be recognized as sound. But in this reconsideration the true facts of the situation should be weighed, not alone that economic disruption may be avoided but with a view to the larger purpose of establishing a road program that will be a secure foundation for future service.

PICTURES IN THE NEWS

SUSPENSION ANCHOR PIER and arch abutment for the new Thousand Island Bridge over the St. Lawrence River. The second abutment for the arch span may be seen in the right background. The suspension span is over one of the main channels.

Photo by R. F. Leon

FIG. 1. GHRIB DAM OF PLACED ROCKFILL FOR IRRIGATION WORKS IN ALGERIA

Algerian Dams of Placed Rockfill

by I. GUTMANN

Editor, Engineering Index, New York, N. Y.

Recent irrigation dams in Algeria indicate a focusing of practice on placed rockfill, with upstream decks of asphalt or concrete paving

ROCKFILL DAMS included in the current program of the French government for irrigation development in Algeria indicate a trend toward standardization on new lines. Dumped fill is definitely abandoned; all rock is machine and hand laid in the body of the fill as well as in the crest and slope zones. Exhaustive precautions are taken to control seepage and underflow by barriers and elaborate provisions for drainage; indeed extreme caution is characterized by overlapping safety provisions. And finally rational design based on theoretical and experimental studies is being striven after with an insistance which makes usual rockfill dam practice seem intuitive by comparison.

These unusual precautions are probably due in part to the unfortunate experience, fresh in the minds of French engineers, with the Wed Kebir rockfill dam, 112 ft. high, built in 1922-1925 for the waterworks of the city of Tunis. This dam, famous for its hollow, multiple-arch concrete core set vertically in the center of a loose rockfill, suffered a partial failure in the flood of 1929, when the corewall sheared off the cutoff wall and deflected downstream. The design of this dam was described and criticized by the late Dr. F. A. Noetzli (*ENR*, Nov. 2, 1932, p. 529) and also by L. F. Harza and others (*ENR*, Dec. 29, 1932, p. 786). It was repaired during 1930-1931, and incidentally, in spite of the pessimistic predictions of the critics, it successfully withstood within a few months after repairs, a flood of practically the same intensity as that of 1929, and no abnormal displacement has been observed in it since that time.

This performance is accepted by some French engineers as a rehabilitation of the principle of the central concrete corewall, which as they point out is more economical (30 per cent saving as compared with an inclined upstream deck) and also offers such advantages as simple construction of the cutoff wall by mere prolongation of the corewall downwards and protection of the corewall by rockfill against shrinkage and temperature variations. While the idea of the central concrete corewall is not dead, yet, to judge by the new crop of Algerian rockfill dams, it is certainly in temporary abeyance, since all four of them have inclined impervious decks on their upstream faces.

What is dead, insofar as French engineers are concerned, is the practice of loose-dumped rockfill; the fill of all the new dams has been carefully placed by machine and by hand. Furthermore, all these dams are provided with heavy cutoff walls carrying inspection tunnels for their entire length; have deep grout curtains upstream of the cutoff walls, and have downstream faces sloping 4 on 5 and upstream faces of variable slope vertically concave. Add to these, freeboards of 13 ft. or more

PRINCIPAL FEATURES OF NEW ALGERIAN ROCKFILL DAMS

Name of Dam	Maximum Height, ft.	Crest Length, ft.	Volume of Rock Fill, cu. yd.	Impervious Deck	Freeboard of Reservoir, ft.	Approximate Cost
(1) Bakhadda	146	722	420,000	Reinforced concrete, 28 in. thick	19.7	$8,000,000
(2) Fum-El-Gueiss	75.5 ultimately 92	820	170,000	Reinforced concrete, 8–14 in. thick	12	$3,000,000
(3) Ghrib	233	886	855,000	Bituminous concrete, 12 in. thick	24.6	$19,000,000
(4) Bu-Hanifia	180*	1,510	1,000,000	Bituminous concrete	16.4	$22,000,000

* Maximum depth of cutoff wall is 230 ft.

and thorough drainage of the dam foundations, and there is had a definite picture of French progress towards standardization of rockfill dam construction.

Four dams are included in the current construction program as specified in the accompanying table. As these dams are being constructed, the structure above the streambed is not of sole concern; there is quite as great engineering novelty and importance in the design and construction of the structure hidden below the streambed—in underdrainage, cutoff walls and grout curtains—as in the placed rockfill and impervious deck construction which are the subjects of the present article. A subsequent article will describe the underground structures.

Sites on bad ground

In general the sites of the dams disclosed about every variety of unfavorable subsurface material. Some of this variety can be indicated but in most cases the complexity of the geological structure is almost beyond description. At Bakhadda a sound sandstone seemed to be indicated, but when construction of the diversion tunnels was undertaken the sound rock was found to cover upturned, fractured, marly sandstones, poorly-cemented conglomerates and spongy limestone. This discovery worked veritable havoc with the design, construction plan and cost estimates; the volume of the rockfill had to be increased, the design of the cut-off walls had to be made more generous and extensive cement grouting had to be provided for.

At Bu-Hanifia a superficial marly sandstone covers compact impervious marls which disintegrate rapidly on exposure; these occur in lenses, all badly faulted in both directions, of poor marl, cemented sandstones, irregularly-graded marly sands, puddings and intermediate gradations. Again at Ghrib a non-uniform, loosely-cemented sandstone covers, at a depth of about 52 ft., a yielding blue marl which readily disintegrates when exposed to air or water.

In section the dams are all plain trapezoids differing only in angles of upstream slopes; Fig. 2 shows the sections of the three large dams. The downstream slopes are uniform and, as stated, the upstream slopes are vertically concave. The angles of slope do not differ widely and are definitely steep as compared with dumped rockfill.

Rockfill is laid rubble

The rockfill for all dams is substantially similar; it is virtually cyclopean rubble masonry carried up in horizontal lifts. At the slopes and crest are zones of more-carefully selected and fitted stone. The practice at Bakhadda is typical except in size of rock used. Though maximum size of rock was desirable, the nearby quarry because of its peculiar fracturing planes furnished rock averaging only about 3 tons in weight; 5-ton pieces were exceptional. The rock was conveyed by chutes to the construction site, where it was picked up by steam cranes, running on tracks, which deposited the pieces about where they belonged. Final placing was done with jacks and crowbars. Smaller size material to fill the voids was placed by hand. The dam was built up in lifts from 13 to 16 ft. high.

For a thickness of about 20 ft. at the faces, selected material was laid in courses perpendicular to the faces, to obtain greater stability, better support for the upstream deck and aesthetic appearance for the permanently exposed downstream face. The fill averaged 32 per cent of voids. At the crest, it was made slightly over high and wide. Subsequent experience indicates that the crest should have been made slightly rounded in profile and a little convex upstream in plan; models of rock fills subjected to repeated shocks, simulating earthquake effect, indicated a tendency to flatten out, producing a crest of rounded profile. Subsidence was observed to be quite regular, with no swellings or hollows. The maximum displacement of the crest was about 12 in., both vertically and horizontally.

Some variations are noted at Bu-Hanifia and Ghrib, particularly in the size of the rock used. Better quarry conditions made larger sizes possible. At Bu-Hanifia (Fig. 3) rocks of 2 to 7 tons were numerous, 7- to 11-ton pieces were frequent and occasional 16-ton blocks were quarried. Here the zone of selected stone was about 11½ ft. thick at the upstream

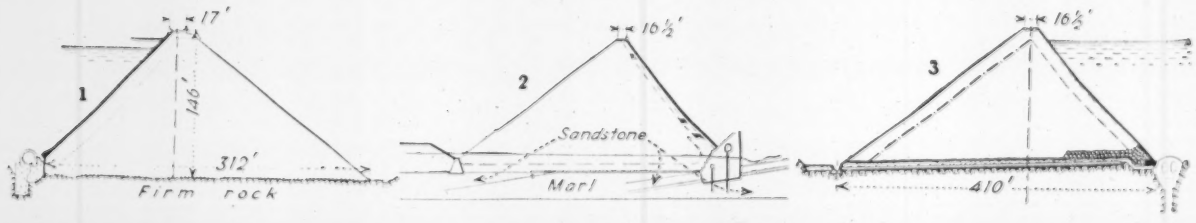


Fig. 2. The sections of placed rockfill irrigation dams in Algeria (1. Bakhadda, 2. Ghrib and 3. Bu-Hanifia) are notable for their steep slopes. They feature also inspection galleries and high freeboard.

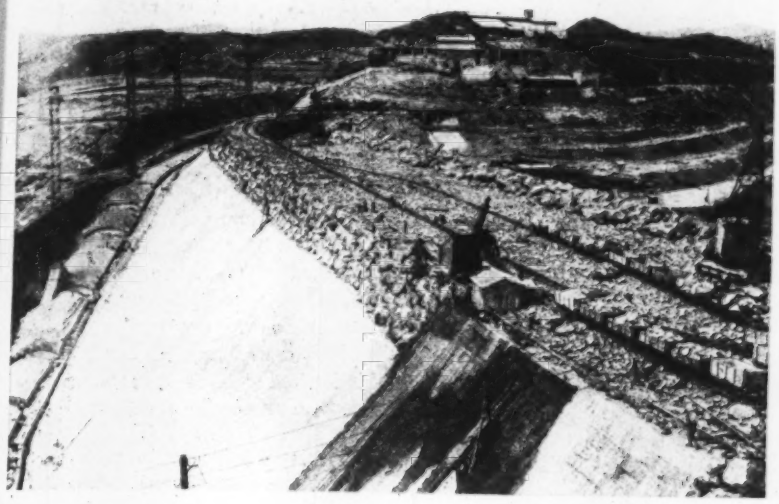


Fig. 3. Both the body fill and facing of rock were carefully placed by hand and cranes as shown by this view of operations at the Bu-Hanifia dam.

face and 16½ ft. thick on the downstream face. At the upstream face also the slope rock was laid in a lean gravel concrete. The voids in the rockfill ran about 27 per cent. At Ghrib the fill was equal parts 1½ to 9-ton rocks, ¼- to 1½-ton rocks and pieces weighing from 10 to 750 lb. The voids ran about 25 to 26 per cent. The fill was carried up in 16-ft. lifts. The selected rock zone on the upstream face was 33 ft. thick at the base and 10 ft. thick at the crest. At Ghrib, too, the facing rock was laid for greater stability in horizontal courses instead of in courses up and down the slope as was done at the other dams. Observations of settlement at Ghrib showed ground subsidence of about 6 in.; settlement of the rockfill amounted to about 22 in.

Except at Bakhadda the rockfill was placed on some sort of foundation mat designed primarily for drainage but also serving to distribute the load. At Fum-el-Gueiss and Ghrib the mat was concrete and at Bu-Hanifia it consisted of layers of sand, gravel and stone designed as a special drainage measure as described in the second article.

Two-course concrete deck

To make the rockfills watertight the upstream slopes are covered with an impervious pavement or deck. Concrete decks were adopted at Bakhadda and Fum-el-Gueiss; that at Bakhadda is of most striking design. This dam is of two-course construction.

Base Slab—The top zone of selected rockfill was coated with a thin layer of gunite and painted with a double coat of coal tar. Next, the concrete base slab was constructed; this is about 12 in. thick and is heavily reinforced top and bottom. A horizontal semi-articulated joint is provided at the junction of the base slab with the top of the cutoff wall. These details are shown by Fig. 4.

Water Test—To give the dam a preliminary test following the construction of the base slab, the reservoir was filled with water and was kept full for seven months. No cracks appeared in the slab, and leakage through the dam was insignificant, never exceeding about 0.5 cu. ft. per sec. Fig. 5 presents a most interesting record of the behavior of the crest of the dam in response to the filling and draining of the reservoir: Note that displacements and settlements were of the order of about 1 ft., and that the rockfill profile displays a slightly elastic, recuperative tendency after its major deformation following the first filling of the reservoir.

On the basis of this observation and others, Henry Lossier, who acted as consulting engineer, suggests that a reasonable assumption for the normal subsidence of a new rockfill may be about 2 per cent of its height. With this assumption, a simple analysis shows that the maximum thickness of an upstream concrete deck, inclined at an angle of 45 deg., and with a working stress of about 700 lb. per sq. in., may not exceed 1/60 of the height of the dam. Further rough analyses also indicate that the vertical flexibility of an impervious deck should be about twice its horizontal flexibility and that extra flexibility in a horizontal direction should be provided at abrupt changes in the profile of the dam.

Surface Slab—After this test, the reservoir was drained, the face of the base slab was cleaned and painted with several coats of coal tar and the top slab of the concrete deck was started. The top slab is about 16 in. thick and is doubly reinforced

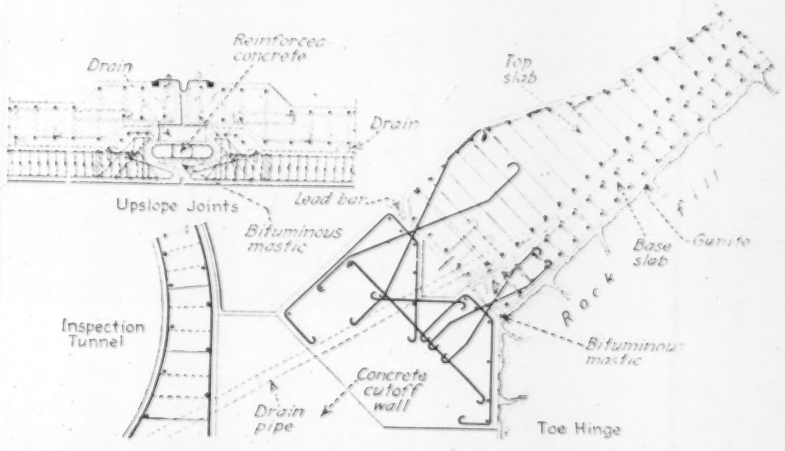


Fig. 4. The two-course concrete paving on the upstream slope at the Bakhadda dam included interesting designs of upslope joints and toe-wall hinge.

with round bars, about 9/16 in. in diameter, spaced about 6.3 in. apart. Its joints, located exactly over the joints in the base slab, consist principally of V-shaped copper strips a little over 1/16 in. thick fixed to the concrete with bronze bolts and bronze screws set in lead. The joints end about 3 ft. short of the junction of the concrete deck with the top of the cutoff wall. The plane of contact between the two is padded with a double layer of asphalted fabric and tightness along this plane of contact is secured by a bar of hammered lead, placed in a horizontal groove at the upstream face, and a sliding tar-painted copper strip at the downstream face of the deck.

At present leakage through the impervious deck amounts to about 0.14 cu. ft. per sec. More than one-half of this quantity is due to two weak spots in the membrane which will be repaired when the reservoir is drained again—so that in the near future the total leakage will amount to only about 0.05 cu. ft. per sec., and since this leakage comes through extremely narrow channels, the chances are that it will be reduced still further by gradual silting up.

The concrete deck of Fum-el-Gueiss is like that at Bakhadda, except that the thickness varies from 14 in. at the base to 8 in. at the crest.

Jointless asphalt deck

The height of dam and uncertainty of foundation at Ghrib and at Bu-Hanifia indicated something more flexible than concrete for upstream decking and it was decided to use

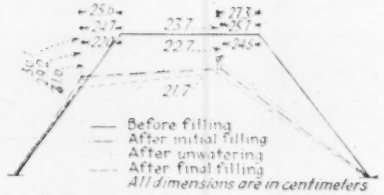


Fig. 5. **Interesting crest and slope deformations caused by filling, emptying and refilling the reservoir at Bakhadda dam.**

bituminous concrete. The deck design for Bu-Hanifia is awaiting further research work but that at Ghrib has been constructed as described here.

Bituminous Mixture — Laboratory and field tests were made to develop an impervious mix that would bond with the masonry, spread easily, lend itself to rolling, have mechanical strength and be stable at reasonable temperatures. A mix with a bitumen content of 8 per cent of the dry weight of the aggregates was designed. The bitumen qualities specified are: Density at 15 deg. C., 1.02 to 1.05; ductility at 25 deg. C., measured by Dow apparatus—0 to 5; penetration 20 to 30; portion soluble in carbon disulphide—99.9 per cent; flash point 240 deg. C. or higher; paraffin scale 2 per cent maximum. The composition of the bituminous concrete is as follows:

Item	*Per Cent*
Calcareous rock, 1 in. to ½ in.	30
Calcareous rock, ½ in. to 0.2 in.	15
Screenings, 0.2 in. to 0	25
Dune Sand	20
Filler	10
Total	100

Deck Construction—The masonry pavement at the upstream face of the dam is covered with a 3-in. layer of special porous concrete (Fig. 6) which bonds perfectly with both the underlying masonry and the overlying blanket of bituminous concrete. This porous concrete also acts as a filter bed subdraining the bituminous concrete blanket, it is air sprayed with a mixture of 75 per cent bitumen and 25 per cent gasoline at the rate of about 3 lbs. per sq. yd. of surface and then a layer of bituminous concrete, 2⅜ in. thick, is applied and rolled, after which a second layer of bituminous concrete of the same thickness is applied and also rolled. Finally the bituminous-concrete deck is covered with a layer of porous concrete serving as protection against heat.

This insulation is considered to be very important since bituminous concrete loses its stability at temperatures above 113 deg. F. Though the average summer temperature at the dam site does not exceed 94 deg. F., the black surface, when exposed to the rays of the sun, has been known to attain temperatures as high as 160 deg. F. This protective layer of concrete is about 4 in. thick and is divided by joints into uniform slabs, about 10 x 6½ ft. in area. It is reinforced with a super-flexible netting of special galvanized steel suspended from the crest of the dam. During very hot weather the exposed protective layer is continually sprinkled with water.

To apply the bituminous concrete the aggregates and the bitumen are heated to about 383 deg. F., (not to exceed 392 deg. F.) and are mixed for 2 min. The mix is transported to the site in fast heat-insulated trucks. The placed mix is rolled with cylinders 32 in. in diameter, pulled horizontally along the contours, not up and down the slope of the dam, producing a perpendicular pressure of about 430 lb. per sq. in. The temperature of the bituminous concrete when rolled should be not less than 203 deg. F. at any time, preferably around 250 deg. F. The first layer of bituminous concrete is painted while still hot with a broom dipped in hot bitumen, at the rate of about 2 lb. per sq. yd., and after cooling, the second layer is applied.

The equipment (Fig. 7) for placing the bituminous concrete consists of: (1) An inclined long-span transporter bridge, paralleling the slope of the dam, carrying a monorail for

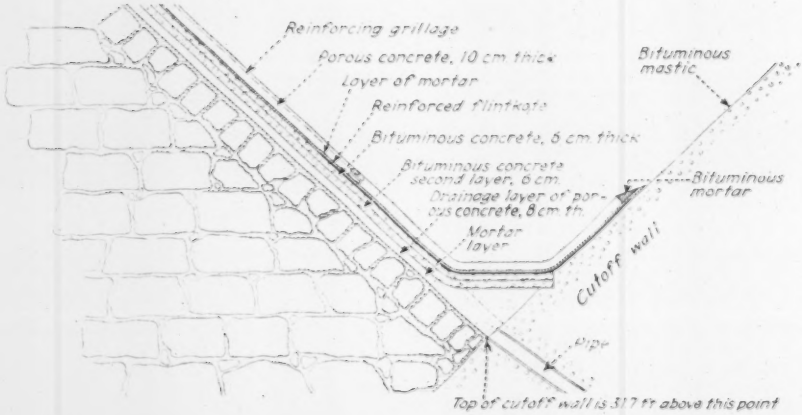


Fig. 6. **Bituminous concrete upstream slope paving for the Ghrib dam included special construction details at the junction with the toe-wall.**

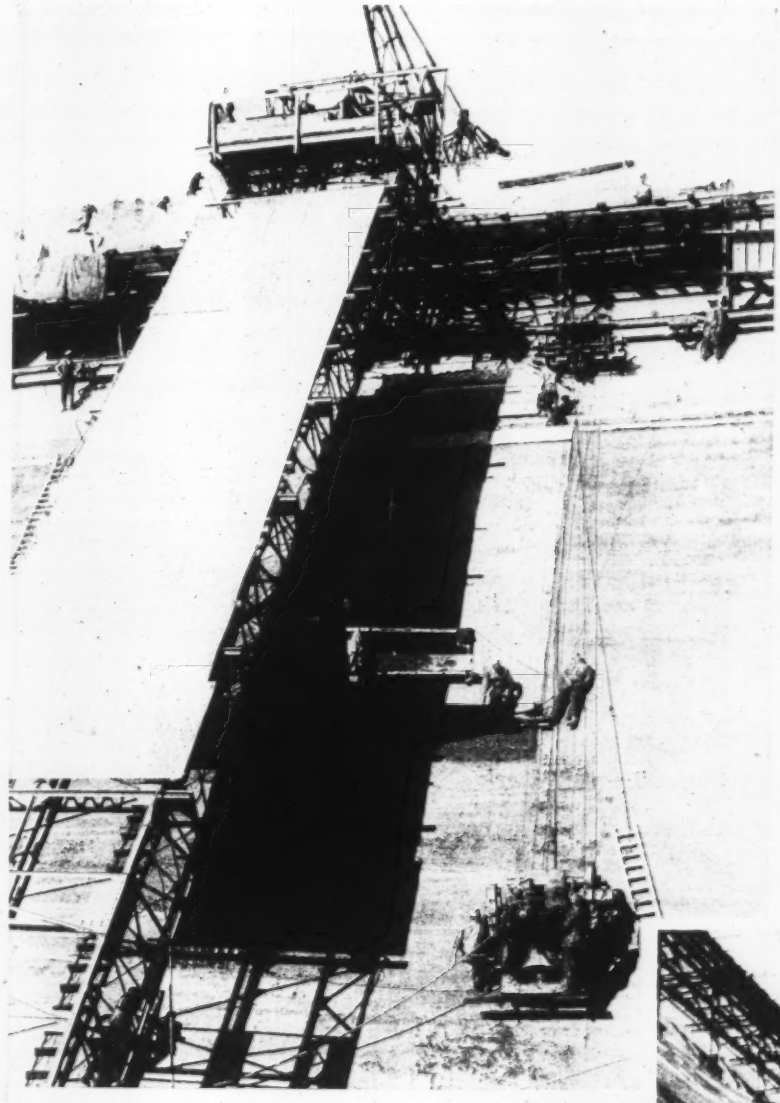


Fig. 7. Asphalt facing for Ghrib dams was placed by a traveler and rolled by special roller hung from the dam crest.

the bucket and a movable working platform; this transporter can be moved horizontally along rail tracks. (2) A roller cylinder with its axis inclined parallel to the slope of the dam, balanced so as to produce uniform compression. The roller (Fig. 8) is equipped with automatic devices for scraping, heating and lubricating the surface.

The connection (Fig. 6) between the impervious deck and the cutoff wall presents an especially delicate problem. Since the subsidence of the rockfill may cause the impervious deck to be translated as well as deflected, this joint has to be particularly flexible, to stand elongation without failure. This is effected by providing a 7-ply layer of cotton fabric impregnated with a special emulsion of bitumen and bentonite, at the rate of 3 lb. per sq. yd.

The cost of the bituminous concrete deck, including two layers of porous concrete, is about 233 fr. per sq. m., which is, according to last year's rate of exchange, about $13 per sq. yd. With the reservoir half full and about 5,400 sq. yd. of the blanket in contact with water, the maximum total drainage from the underlying porous concrete into the inspection tunnel was at first about 32 gal. per minute, then it rapidly decreased to 16 gal. per minute, and has kept on decreasing.

The drainage area of the Bakhadda dam is about 500 sq. mi. Originally the spillway was designed for a capacity of 23,000 cu. ft. per sec., but in view of later experience its capacity was increased to 46,000 cu. ft. per sec. and indeed, in February 1930 a flood of 40,000 sec. ft. passed over the site of the dam. The spillway has a Creager cross section and is 454 ft. long, arched upstream. The design of the spillway and wasteway as checked on a 1/50 hydraulic model will take care of a flood of over 70,000 cu. ft. per sec. with a little freeboard to spare.

The stream at the site of the Bu-Hanifia dam drains an area of about 2700 sq. mi. A flood of over 130,000 cu. ft. per sec. is on record and naturally it was decided to provide a spilling capacity of about 194,000 cu. ft. per sec., in addition to the reservoir outlet which is capable of

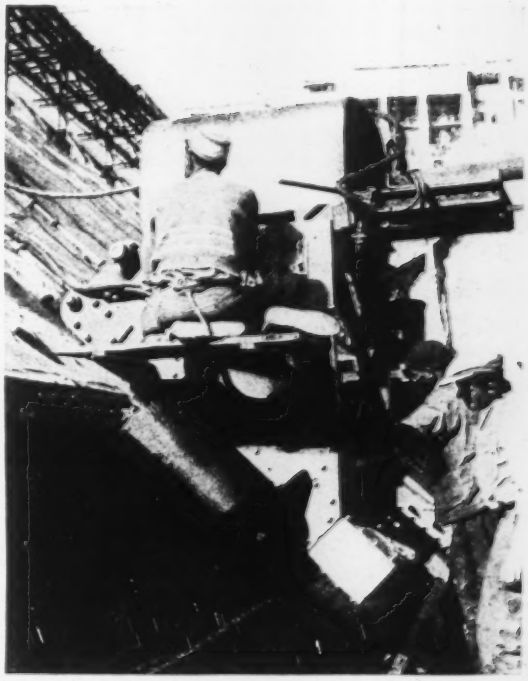


Fig. 8. Special roller compacting slope paving for Ghrib dam. Provision is made for scraping and heating.

discharging some 13,000 cu. ft. per sec. In all there is provision for a flood discharge of about 78 cu. ft. per sec. per sq. mi. of watershed.

The drainage area above the Ghrib Dam is 8900 sq. mi., and a flood of 64,000 cu. ft. per sec. occurred during construction. According to the Fuller formula the capacity of the Ghrib spillway should be 530,000 sec. ft., which is prohibitive and impossible. Fortunately, at Bughzul, 26 mi. upstream, there is a good site for a detention reservoir where an earth dam, about 40 ft. high, was built. The reservoir formed by this dam, together with a spillway of 30,000 sec. ft. capacity, will take care of a maximum flow of 460,000 sec. ft. from the contributing watershed of 965 sq. mi., for a duration of 20 hours. Taking into account the arid nature of the watershed, this means absolute security for all practical purposes.

Between Bughzul and the Ghrib Dam there is an additional watershed area of 965 sq. mi. The flood runoff from this area together with the discharge of the Bughzul spillway will require a capacity of at least 90,000 cu. ft. per sec. for the Ghrib spillway. This spillway has been designed as an overflow dam of the Creager cross-section, arched upstream, practically 600 ft. long. Its spilling level is 21.6 ft. below the crest of the dam. With a head of 10 ft. this spillway will discharge over 70,000 cu. ft. per sec. This discharge can be augmented by opening the gate of the mid-height reservoir outlet which will discharge 18,000 cu. ft. per sec., bringing the total up to the required minimum of 88,000 cu. ft. per sec. With a head of 15 ft., which still leaves nearly 10 ft. of freeboard, the spillway alone will discharge nearly 110,000 cu. ft. per sec. With the water level at the crest of the dam the spillway alone will discharge 140,000 cu. ft. per sec.

The spillway is located at a notch in the rim of the reservoir about 600 ft. from the right abutment of the dam. Its design was checked and rechecked with numerous tests of models made at the special field laboratory. The tests have shown that at a head of about 15 ft. the spillway crest will be submerged and the flow will be controlled by the wasteway.

The wasteway lined with reinforced concrete, (Fig. 1) has within its lower half three arched drops and as many stilling basins and shafts of circular or elliptic cross-section which reduce the velocity of flow to about 33 ft. per sec. or less. It discharges into the river at a point about 400 ft. below the toe of the dam, perpendicularly to the stream. Near its lower end it receives the discharge of the mid-height reservoir outlet mentioned above.

There is an additional low-level outlet having a capacity of 35,000 cu. ft. per sec., located near the left abutment of the dam, which is controlled by a valve tower and a butterfly valve which has a diameter of 8.5 ft.

A subsequent article will describe the subsurface water stops and elaborate drainage systems for these four notable Algerian dams. These involve elaborations in rockfill practice that are quite unusual.

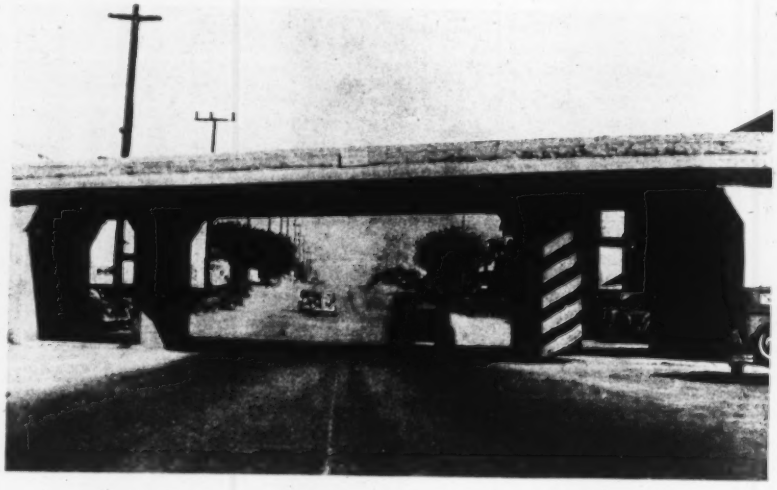


FIG. 1. 24-YEAR-OLD SKEWED FLAT SLAB BRIDGE AT RIVERSIDE, CALIF.

Thin Slab Railroad Bridge In Service 24 Years

A Pioneer of its type in the West, this bridge carries railroad loads on a 40-ft. span

LONG SERVICE without signs of age is the record of a grade separation bridge which carries a branch of the Union Pacific Railway over North Main St. in Riverside, Calif. The structure is a thin, straight, deck slab between concrete abutments, with a pair of heavy columns at the street margins on both sides. The notable feature is that the flat slab deck of 40-ft. span (measured along the railway) has a thickness averaging only 22 in. at midspan and 20 in. at the supports. The main span is flanked by short spans, about 14 ft. in length, extending over the sidewalks which adjoin the street beneath. These short spans are integral at their outer ends with the heavy 27-in. face walls of the abutments. The bridge is on a skew of 29 deg. with the roadway below.

The design is the four-way "mushroom" type, which was adapted in the manner shown in Fig. 2 to the several requirements that affected slab thickness. Viewed in elevation from the street, the abutments are 58 ft. apart, face to face, and the street span is 35 ft. center to center of columns. Vertical clearance at the

center line of the street is 14 ft. 0 in.

The advantages of a shallow deck for a grade separation of this sort are obvious and doubtless determined the type of structure selected. The deck slab is level on its under surface but to provide drainage its upper surface was sloped with a ridge and two diagonal valleys which resulted in making its thickness at the abutments 17 in. on one side, 21 in. at the other. At mid-span, above the center line of the street, the corresponding thicknesses are 21 in. and 24 in. respectively. The deck is 32 ft. wide, between curbs, which are 16 in. wide and have a minimum height of 12 in. The bridge was built to carry two lines of track, 16 ft. on centers. Only one of these was installed—the one on the side where the slab is thicker—and this track is on a rather sharp curve. Superelevation is provided by banking up the ballast.

There are two octagonal columns, 3 ft. in diameter, 17 ft. 5¾ in. on centers, on each side of the street. These have capitals and dropped panels 8 ft. square in plan. The columns are set parallel with the street center line and with the faces of the abutments. They are reinforced with twelve 1¼-in. longitudinal rods wrapped with ⅜-in. round hooping spaced on 4-in. pitch.

When the bridge was built it was given a plaster finish. Small patches of this have been knocked off in places on the under side of the slab where it has been scraped by vehicles which required more clearance than the bridge afforded. Above the east side of the street, and below the railroad track, four or five small cracks spaced about a foot apart and extending for 8 or 10 ft. in a direction perpendicular to the street curb are to be seen in the plaster coat. Whether these are also in the slab itself is not known. There are no signs of leakage in the slab, the top of which, according to the original plans, was to be painted with three coats of Ironite. Except for these minor imperfections and some blotches of discoloration at the abutments, the bridge appears to be in excellent condition after nearly a quarter century of service.

The satisfactory performance of what would be a very thin slab even now is notable for the pioneering conditions under which it was built. The job was undertaken as a city project in 1913. The then city engineer of Riverside called in E. T. Flaherty, a consulting engineer in Los Angeles, to design the structure for Cooper's E-60 loading. The design was complicated by the irregular arrangement of the reinforcement and by the skew of the abutments. Altogether the formwork was a rather forbidding problem to the inexperienced. Probably for these reasons, when bids were invited, the few that came in were far above the engineer's estimate. All bids were rejected and the city undertook the job by day labor.

City provides mixer

The department of streets provided a concrete mixer and other necessary work was carried on under the direction of an engineer hired by the city for the job. This man was E. Q. Sullivan, now district engineer of the state highway department at San Bernardino, Calif. The carpenters had no experience with formwork and, in fact, requirements were new to the entire crew. Despite the fact that all bars were bent by hand on the job, bending and placing was quite accurately done.

Reinforcing consisted of radial and circumferential steel bars in the column heads. Radial steel over the columns was put 4 in. beneath the top of the slab and was bent down to within 1 in. of the bottom. The mix used was 1:2:4 in which the coarse aggregate was crushed limestone. Of the limestone Mr. Sullivan says, "This aggregate would be considered too soft for present-day use but the present condition of the bridge proves that actually it was entirely satisfactory. I recall that the crushed rock was so sharp and angular that the concrete was very hard to work. In those days the idea of using aggregate graded up into the larger sizes was not general but it occurred to us that introducing some larger sizes might help; we successfully increased the top limit of the size of the coarse aggregate with very much better results in working the concrete than was experienced with the standard small sizes.

"All four columns and the abutment walls were poured up to the bottom of the haunches. Then the balance of the bridge was completed in one pouring. We started about 3 o'clock in the morning and kept on until the work was completed late that night by the aid of small kerosene lanterns."

A. P. Campbell was city engineer of Riverside in 1913. Information on which this article was based was obtained from Mr. Sullivan.

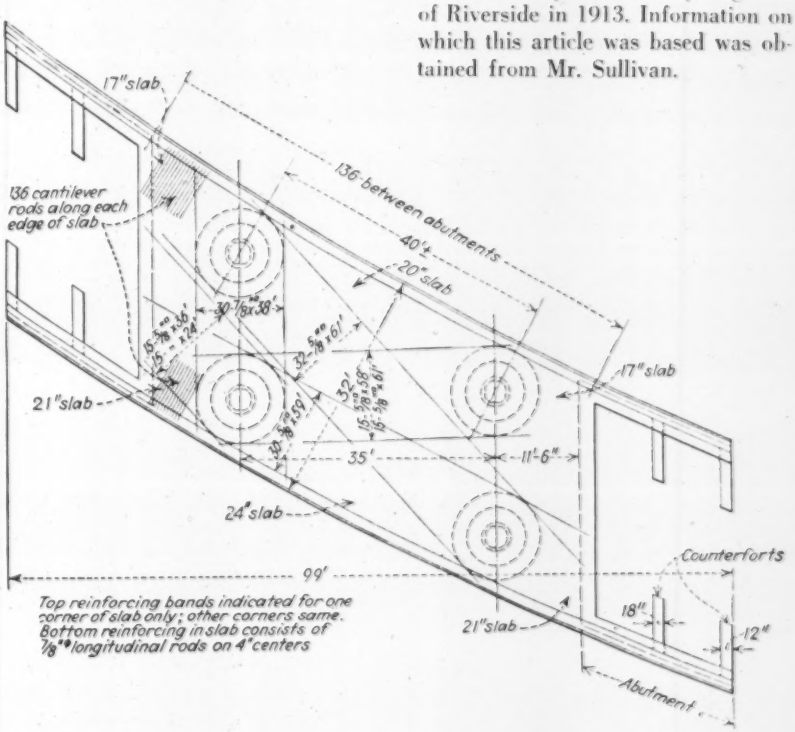


Fig. 2. Four columns carrying the slab are connected by belts of reinforcing rods in both directions and on both diagonals.

Longer Life for Dredge Pumps

by T. B. JEFFERSON

Associate Engineer, U. S. Engineer Office, Fort Peck, Mont.

Studies and experiments at Fort Peck Dam have greatly reduced wear through use of alloys and rubber in vital parts of large pumps handling abrasive materials

Phenomenal performance records are being established by the four hydraulic dredge units at Fort Peck Dam, each with its set of five 28-in. centrifugal pumps. Though the dredging plant was designed for an output of three million yards per month, the pumped yardage has steadily increased during the three years of operations until today it is double the designed capacity of the plant. The development of alloy and rubber materials for vital parts of the pumps subject to excessive wear, thereby increasing the pumping efficiency, is largely responsible for the remarkable dredging record. Experiments and changes in the pumps made on the job are described in the following article. As a background the reader is referred to these previous articles on Fort Peck Dam: Dredging operations, Aug. 29, 1935 and Aug. 6, 1936, p. 188; dredge and pump design, Dec. 12, 1935, p. 810; repair of pumps by welding, Apr. 30, 1936, p. 624.

—EDITOR

DREDGING HISTORY is being made at Fort Peck Dam on the Missouri River in Montana, where the Army Engineers are building a great 100,000,000-cu. yd. earth fill by the hydraulic method. New pumping records are being established, higher pumping efficiencies are being obtained, and finally, new concepts of pump design and materials are resulting from studies and experiments made at the job. The Fort Peck hydraulic plant, with its four 28-in. electric dredge units operating simultaneously and keeping twenty pumps in operation, is a veritable proving ground for dredging and pumping equipment. The pumps and other equipment are subjected to unusual wear, for the material handled is alluvial in character which has not traveled far from its mountain origin and the constituent particles are very sharp and abrasive. Thus the material is different from that found on most dredging jobs, especially in the lower Mississippi Valley, where the particles are water-worn. Because of the length of time involved in its construction and the amount of material to be moved, the engineers have been afforded an opportunity to study thoroughly the operating characteristics of the dredging plant which is being used. As a result of these studies many improvements have been made which have not only increased the operating efficiency of the dredges but greatly reduced the delays incurred for pump repairs and similar delays which can be attributed to minor repairs.

As in all cases where improvements have been brought about by experimentation, not every change has produced the desired objective. Wherever a change was made there was some improvement in the operating characteristics of the dredge. Occasionally, however, there was not so marked an improvement as to warrant adoption of the newer idea.

While many improvements have been made on the dredges as originally designed for use at Fort Peck on the basis of lower river and seacoast dredging experience, the major changes have been made in the dredge pumps. The initial 28-in. pumps were built of cast and rolled steel. The casing and the heads were of a medium carbon steel cast to ASTM A27-24, class B, Medium. specification. The casings of these pumps had integral shoulders to which there had been applied a 3/16-in. overlay of hard facing material. The front head liner was also of cast steel, while the back head liners were made from a rolled steel plate, a nickel-chrome alloy to SAE 3340 specification. The manhole and impeller mouth liners were of this same material.

Inasmuch as these pumps were

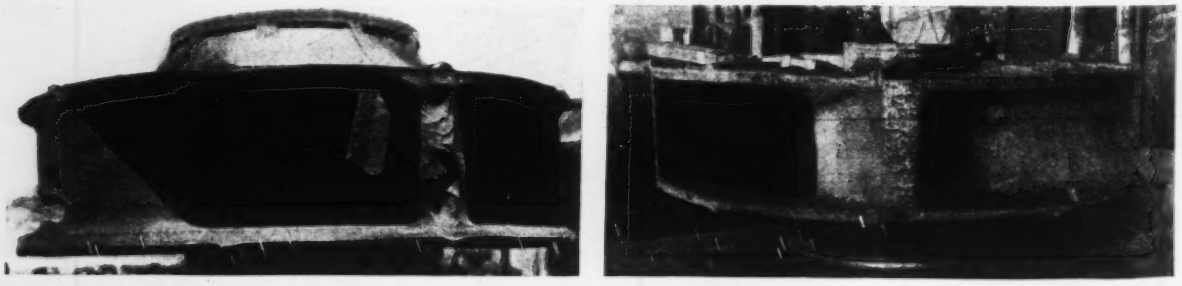


Fig. 1. Impellers on 28-in. dredge pumps at Fort Peck wore out quickly until hard-surfacing was applied to critical points of wear by welding.

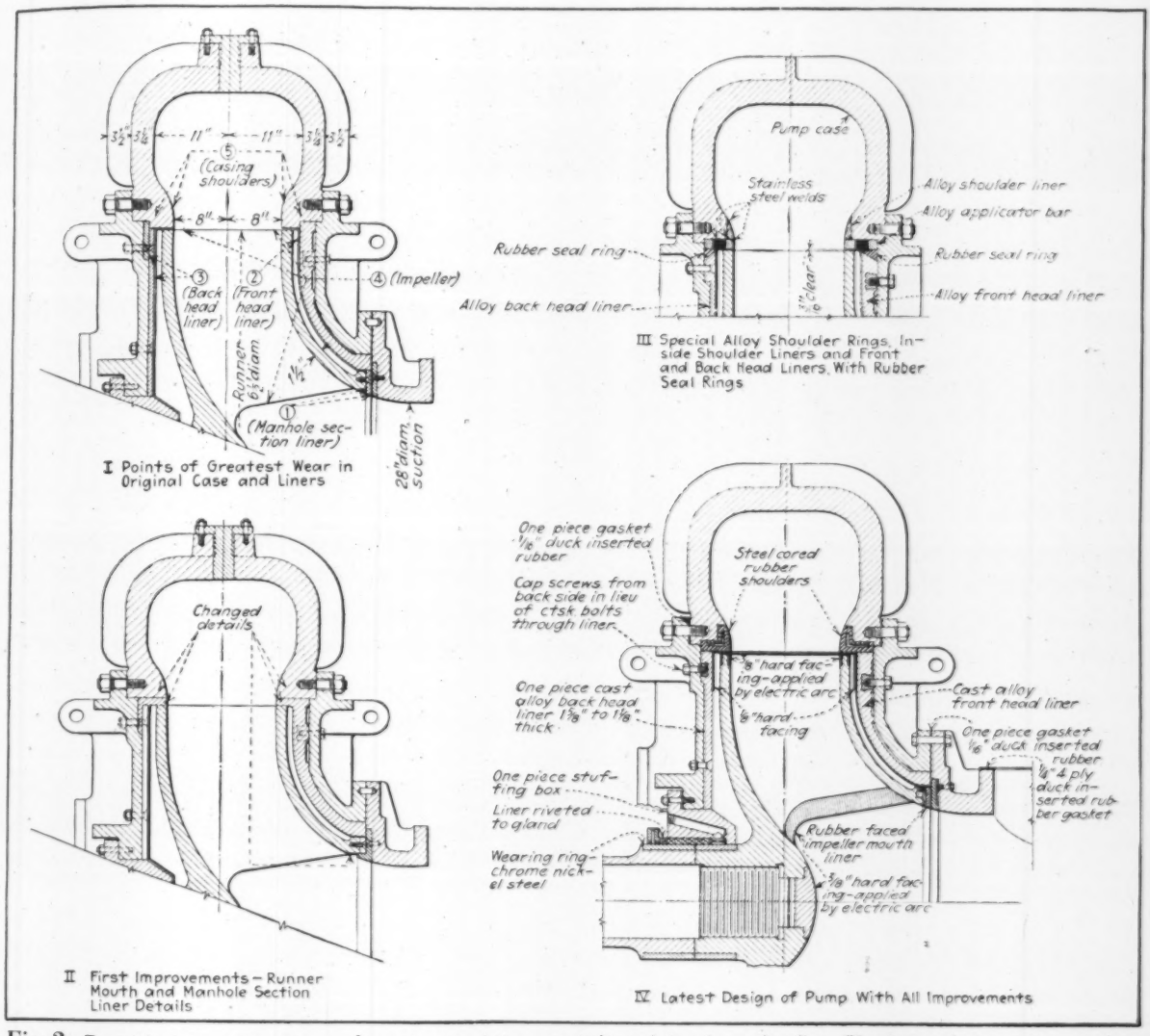

(Casing shoulders)
(Back head liner)
(Front head liner)
(Impeller)
(Manhole section liner)
Runner 61½ diam.
28" diam. suction
I Points of Greatest Wear in Original Case and Liners
Changed details
II First Improvements – Runner Mouth and Manhole Section Liner Details
Pump case
Stainless steel welds
Alloy shoulder liner
Alloy applicator bar
Rubber seal ring
Rubber seal ring
Alloy back head liner
Alloy front head liner
⅛" clear
III Special Alloy Shoulder Rings, Inside Shoulder Liners and Front and Back Head Liners, With Rubber Seal Rings
One piece gasket 1/16" duck inserted rubber
Cap screws from back side in lieu of ctsk bolts through liner
Steel cored rubber shoulders
⅜" hard facing-applied by electric arc
One piece cast alloy back head liner 1⅜" to 1⅛" thick
⅜" hard facing
Cast alloy front head liner
One piece gasket 1/16" duck inserted rubber ⅛" 4 ply duck inserted rubber gasket
One piece stuffing box
Liner riveted to gland
Wearing ring-chrome nickel steel
Rubber faced impeller mouth liner
⅜" hard facing-applied by electric arc
IV Latest Design of Pump With All Improvements

Fig. 2. Pump improvements were made a step at a time, as indicated by these sketches. The latest design uses one-piece alloy back and front head liners, steel-cored rubber shoulders, rubber-faced impeller mouth and manhole section liners and hard surfacing at other points of wear.

quite similar to the dredge pumps which have been used extensively by the various engineer districts throughout the country it was believed that they would be suitable for at least a half season's work under the dredging conditions to be encountered at Fort Peck. Early in the 1935 dredging season, however, it was found that from the standpoint of economical repairs this type of pump could not be expected to render efficient service after having pumped 750,000 cu. yd. of material.

The wear in the pump was distributed about five principal points as indicated Fig. 2—I. After 1,000,000 yd. of pumping the following conditions of wear were found to exist: The manhole section liner (1) was completely worn away resulting in the loss of the liner and severe damage to the manhole section. This was also true of the impeller mouth liner, with much resultant damage to the impeller. The front head liner (2) was so severely abraded that it required replacement. Both the back head liner (3) and the quarter liners were cut and worn about their outer edges to such an extent as to require replacement. The impeller (4) was found to be badly gouged at the ends of the vanes and the periphery of the shrouds had been worn away by the action of sand and water. Likewise, the entrance edges of the vanes were battered and worn, apparently by the pounding action of gravel and boulders which had passed through the pump. Fig. 1 shows the typical worn condition of an impeller.

The manner in which the shoulders of the pump casing were worn by the erosive action of the silt and sand in the water is shown in Fig. 3. The shoulders of the pump case were gouged and abraded so severely that the pump efficiency suffered greatly.

Obviously the overcoming of this excessive wear was one of the major problems confronting engineers engaged in the maintenance of Fort Peck dredging plant. Immediate steps were taken to increase the abrasion-resistant qualities of the equipment. Eventually there resulted one of the most complete and best-

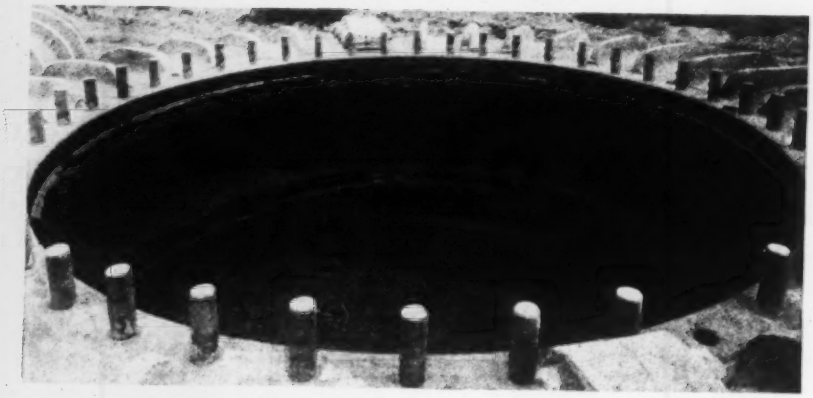


Fig. 3. Missouri River silt is rough on pump casing shoulders as this view shows. This type of wear was first reduced by building up the shoulders with welded hard surfacing; later steel-cored rubber shoulder liners proved even more successful.

equipped welding shops in the country, established on the job for the purpose of repairing and rebuilding the pumps and other dredge parts.

One of the first steps taken toward reclaiming the pumps was to replace by welding that metal which had been eroded from the volute and shoulders of the casing. All of the points showing wear were rebuilt and hardfaced. For economic reasons, welding repairs were undertaken only on the pump case and the impellers. However, whenever any of the supporting members of the liners were abraded they were likewise rebuilt by welding.

An idea of the amount of metal which is worn from one of these 18-ton pump casings during a million yards of pumping may be gained from the fact that as much as 2,600 lbs. of weld metal has been used in restoring a single pump to its original condition. An average of 1,100 lbs. of weld metal per pump is used in rebuilding worn pumps.

Electric welding used

Through the use of electric welding and a more complete application of hardfacing (by which both the shoulders and volute of the case were protected by means of an abrasion-resistant overlay) the economical life of the pumps was increased to approximately 1,000,000 yds. This increase was realized before the close of the 1935 dredging season.

While the use of hardfacing increased the life of the shoulders and the impellers, the various liners were still subjected to the wear which was experienced in the original pumps. The next problem was to increase the life of the liners so as to equal that of the pump.

It was found that the life of the back head liner could be lengthened somewhat by increasing the amount of service water introduced to the pump gland; the surplus water of the gland washed the liner with clear water keeping it free of silt-laden waters and thus reducing their erosive effects. This, however, did not in any way relieve the conditions affecting the other liners.

To increase the life of the front head liner, a new type was devised in which the pump shoulder was incorporated as a part of the liner. The details of this application may be seen in the pump section shown in Fig. 2—II. In this experimental installation the original shoulders of the case were removed. The back shoulder was replaced by an angle-shaped liner, divided into quarter segments. One leg of this angle took the place of the original back quarter-liner, while the other leg formed the shoulder section at the periphery of the impeller. These liners were held in place by the original bolts and the usual installation of the back head liner. The front head liner was cast with an angle lip, forming the front head liner and the front shoulder in one piece. All of these liners were made of a nickel-chrome cast iron alloy and because of this composition they were brittle. Although they were highly satisfactory from an abrasion-resistant standpoint, portions of the shoulder section of the liners were broken out while in service. Liner failures due to breakage caused this style of liner to be abandoned. However, it was considered to be a step in the right direction.

During the early part of the 1936 dredging season new pump casings were purchased. These cases were machined in the shoulder section to receive a specially-designed cast shoulder applicator bar. These applicator bars were made of a nickel-manganese alloy in sets, consisting of two rings of eight segments each, and were plug-welded to the pump case. To protect the volute of the pump, another set of applicator bars, of similar material, were plug-welded to each side of the volute at the shoulder of the case. Another cross-section of the pump, Fig. 2—III, shows the details of this application. This detail also pictures rubber gaskets, or seal rings, between the outer edges of the front and back liners and the applicator bars.

Since much of the wear on both the front and back head liners appears to begin at the junction line of the liners with the case, it was believed that if a rubber gasket was placed between them, much of the wear would be taken by this gasket. This did not prove to be the case, so after one experimental installation, the use of the rubber rings was discontinued. Upon discarding the rubber seal rings, the front and back head liners were machined so as to slide into place on top of the applicator bars.

Repairs made quickly

The applicator bars, held in place by the plug welds, could be installed or removed without much work. Therefore the amount of welding required in rebuilding the casings was greatly reduced and the repair jobs were completed more quickly. Trial runs proved that these nickel-manganese bars, which were of an austenitic structure, did not have an opportunity to work-harden and, therefore, proved unsatisfactory on this installation as they did not resist abrasion as anticipated. As a result of this experience, applicator bars which had been fabricated in the shop were placed in the pump. These shop-fabricated bars were made of nickel-chrome steel curved to fit the pump casing and hardfaced on their exposed areas. This type was also plug-welded in place

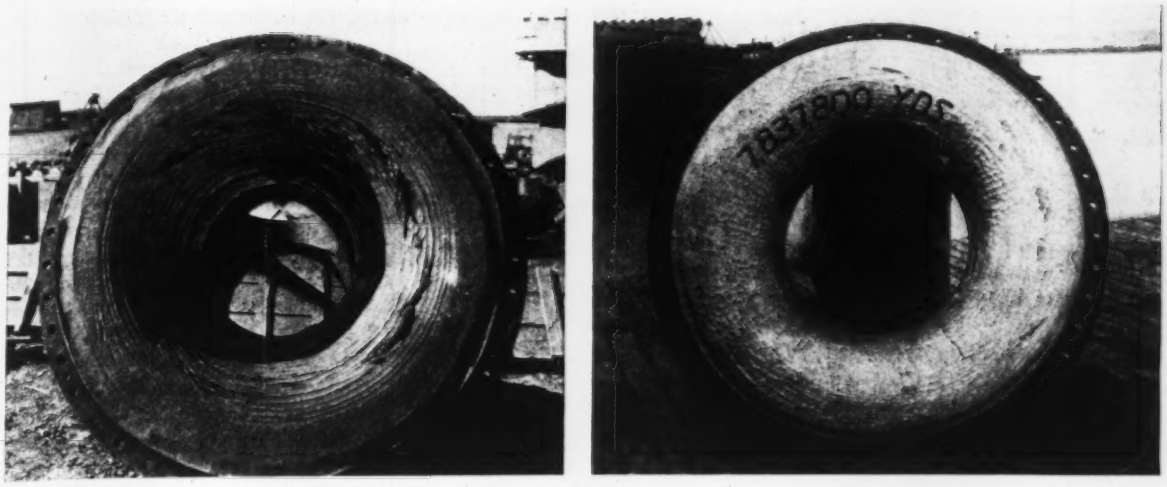


Fig. 4. Original front head liners of cast steel wore out with a million yards of pumping. New design liners of chrome-iron alloy have pumped eight million yards and are still serviceable.

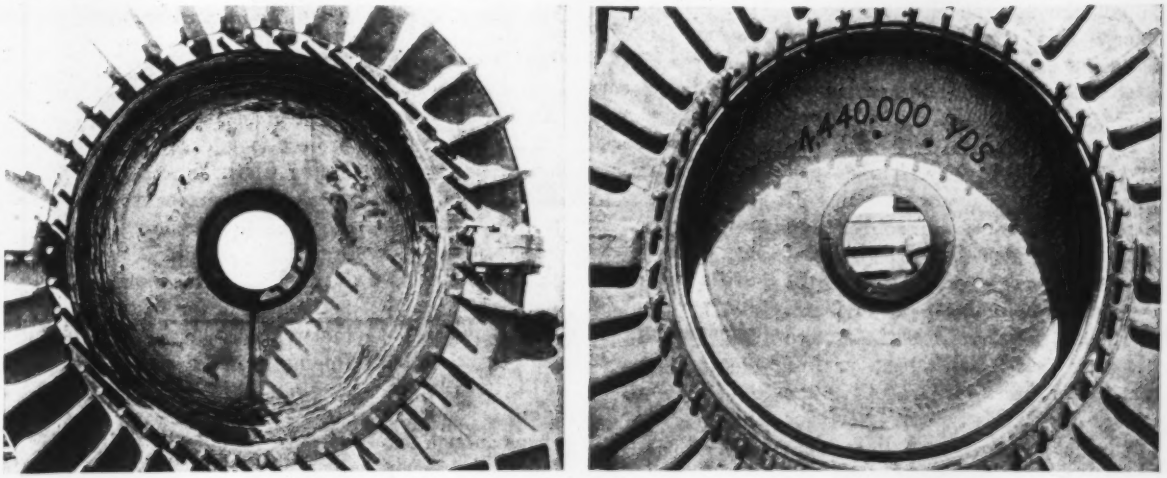


Fig. 5. Back head liners were just as vulnerable to abrasive wear as were the front heads. The condition of an original cast steel liner (left) after pumping 1,500,000 cu. yd. is shown in comparison with that of an alloy liner after pumping three times that amount. The new rubber casing shoulder liner can be seen in the right view.

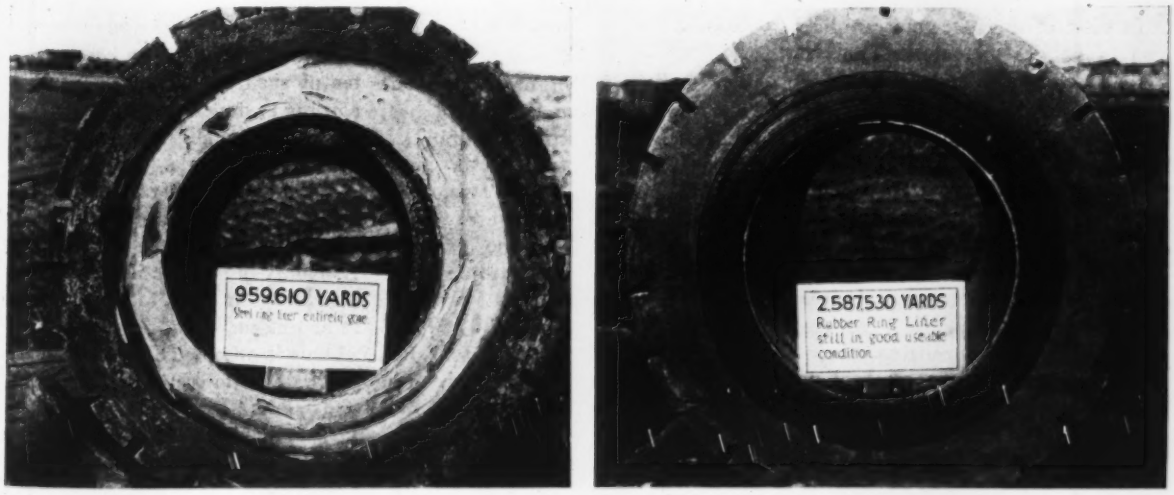


Fig. 6. Steel-cored rubber ring liners in the manhole (intake) section are the answer to excessive wear conditions that made short work of the original steel ring liners.

Dredge	Pump Repair Delay To Sept. 1, 1936	Pump Repair Delay To Sept. 1, 1937	Per Cent Reduction 1937 over 1936	Material Pumped, Cu. Yd. to Sept. 1 1936	Material Pumped, Cu. Yd. to Sept. 1 1937
Gallatin	43 h 57 m	20 h 33 m	52.9	5,218,730	6,091,040
Jefferson	50 h 19 m	21 h 27 m	56.5	4,774,160	6,777,570
Madison	56 h 40 m	18 h 38 m	67.1	5,144,330	5,925,520
Missouri	64 h 12 m	23 h 32 m	63.3	6,257,370	6,278,870
Total	214 h 47 m	81 h 11 m	60.8	21,394,590	25,073,000

in the casing. While the use of the applicator bars was advantageous from the point of simplicity of repairs it was evident that they would not increase the life of a pump as expected.

It was becoming apparent that the use of extra-hard metals on the shoulders of the pump case was not the solution to the wear problem at hand. At the same time that these experiments were being carried on to increase the life of the pump, more successful parallel experiments had been completed on the impeller mouth and manhole section liners. This was accomplished by replacing the original nickel-chrome steel liners with steel-backed rubber liners. In this application, rubber of a durometer hardness of 50 was vulcanized to steel rings. These steel rings served a dual purpose; that of rigidly supporting the rubber and of providing a method by which set screws and cap screws could be fastened to hold the liners in place. A rubber manhole liner in service pumping over 2,500,000 cu. yds. of material is shown in Fig. 6. Note the superiority of this type of liner over the initial type of steel liner completely worn away, with serious damage to the manhole section, in less than a million yards of service.

Reinforced rubber shoulder

In view of the successful application of rubber to the manhole section and impeller mouth liners, it was decided to try rubber at the shoulders of the casings in the form of rubber applicator bars to be held in place by cap screws. To take the place of the hard metal applicator bars which had been used previously, an angle-shaped steel-reinforced rubber shoulder was devised. These rubber shoulders were also made up in sets consisting of two rings of eight segments each. Each segment had its ends beveled on a 45-deg. angle, overlapping in the direction of rotation of the impeller, the joint treated with cold-patch material. In this manner, each segment became firmly bonded to its adjacent segment forming a solid rubber ring when installed in a pump. A section of the pump showing the rubber shoulder installation may be seen in Fig. 2—IV. A trial run with the rubber shoulders near the close of the 1936 dredging season showed conclusively that they were the most satisfactory means yet developed for overcoming erosive wear in dredge pumps. As result of this run, plans were made to fit all the pumps to be used in the 1937 dredging program with rubber shoulders. The use of rubber shoulder liners has increased the average life of a pump casing to over 2,000,000 cu. yd.

Meanwhile, further experiments were being carried on in an effort to obtain more abrasive-resistant front and back head liners for use with the rubber shoulders. Finally, a chrome cast iron alloy was adopted for this use. This material, as cast, has a Brinell hardness of about 600 and a tensile strength of over 50,000 lb. per sq. in. Due to the high physical properties of this metal, the liners are hard enough to resist the most abrasive action likely to be imposed while pumping sand-water mixtures. Also they have enough tensile strength to withstand the shocks and severe impact to which they are subjected while pumping gravel and glacial boulders. Comparative views of old and new front head liners are shown in Fig. 4. The initial type cast-steel liner wore out under 1,470,500 cu. yd. of pumping. Note how the liner has worn to such an extent that even the front head has been damaged, requiring repairs. The chrome cast iron front head liner, after 7,837,800 cu. yd. of service, is still suitable for further use.

Fig. 5 shows how the original pump with its nickel-chrome steel plate back head liner has been so severely abraded after 1,470,500 cu. yd. of pumping that it is unfit for further service without extensive repairs. This same illustration shows by contrast the excellent condition of a rubber shoulder equipped pump fitted with chrome cast iron back head liner after 4,440,000 cu. yd. of pumping.

In overcoming abrasion problems of the Fort Peck dredge pumps, those problems presented by the impeller were the least difficult. There is a tendency for an impeller to develop individual flow characteristics which always result in wear at the same points. Thus, after the initial weak points were reinforced by welding and hardfacing, there were only a few places which could be attacked by erosion, so the wear became comparatively uniform. Fig. 1 shows a completely-reconditioned and hardfaced impeller.

The accompanying table compares the delay time, during the operating season, chargeable to pump repairs on the four Fort Peck dredges up to Sept. 1 of the 1936 and 1937 dredging seasons. This tabulation clearly indicates the reduction of time loss due to pump repairs.

Supervision of project

All of the work on the Fort Peck project is under the supervision of Major Clark Kittrell, District Engineer. The maintenance and development of the dredging plant herein described is under the direction of D. B. Botkin, Senior Engineer, who is the head of the Plant Section, with the writer as Assistant to the Plant Engineer in direct charge of the shops.

• • •

Personnel Administrators To Be Registered

GOVERNORS, mayors and other government officials who are seeking qualified personnel administrators will in the near future have a register of such individuals at hand, according to announcement of the Civil Service Assembly of the United States and Canada.

As adopted by resolution at its recent annual conference (Ottawa, Can., Oct. 4-8), the Civil Service Assembly is to establish professional standards in public personnel administration.

This is one of the first attempts of a group of public officials to impose and administer professional standards in its own field, it was said, and it may be compared to the professional standardization of physicians, engineers, architects and other groups in private endeavor.

Problems of Housebuilding Revival

Intelligently guided rental enterprise advocated by speakers at Washington Conference on Residential Construction, including federal housing representatives

RENTAL enterprise was pointed out by speakers at the recent Washington Conference on Residential Construction as the most likely means for restoring activity in housebuilding. Active support for rental housing was promised by the Federal Housing Administration. John H. Fahey, chairman of the Home Loan Bank Board, asserted that business men and local civic interests can exert a powerful influence in housebuilding revival but up to now have failed to do so, having "largely taken it out in talk."

As reflected in the following abstracts of major points made at the conference, lack of adequate construction statistics and shortcomings of zoning were included among the factors that discourage the growth of housebuilding, while neglect of the rental market was held chiefly responsible for the present failure of housebuilding to return to normal.

Forecasting Building

by LOWELL J. CHAWNER

Chief, Construction Economics Section, Department of Commerce, Washington, D. C.

In the past, builders and property owners have expanded or curtailed their activities largely by aiming in the dark. Comparatively inexpensive methods, such as vacancy studies, make it possible to secure comprehensive factual information on the market demand for house building.

Vacancy surveys in Denver and a few other cities date from 1930; an extensive real property inventory was made in Cleveland in 1933; similar inventories in sixty-four cities were made in 1934. The vacancy survey in Denver, which is made in September of each year, is made at a cost outlay to the local business interests in that city of approximately $250 annually. At least a simple inventory of this character should be made in the spring and fall of each year in each city of 10,000 or more.

It is also important that statistics be available on population growth and the number of families added annually, together with migration trends. By observing carefully the simple facts of number of families added in a given area and current occupancies and vacancies it is possible for builders to adjust their operations intelligently to these needs.

Residential building does not occur as the result of erratic uncertainty but does develop from basic economic and social conditions. Among the controlling principles are: Increase in the number of families in a given area, through marriages and migrations, tends to increase building activity. Increase in the levels of family income has the same effect. Increase in the cost of other items of family expenditure than housing tends to decrease building activity. The costs of home ownership also exert an influence; high financing costs, high construction costs, high site costs, high taxes and other costs tend to retard new construction.

The way to get at the housing problem is through facts and figures and careful observation of the economic process by which residential shelter is provided. This is an endeavor in which all who will may share; government agencies can assist materially, but local business groups will largely determine its final success.

Profits Through Rents

by CHARLES F. LEWIS

Director, the Buhl Foundation, Pittsburgh

The shift from a village to an essentially urban society has brought complexities with which the family alone is no longer able to deal. In the small social order the common aspiration of every family was to own its own home. Under the new order, for great numbers of our people all of the once-vaunted glories of home ownership have passed; the old shibboleths have lost their meaning, and only the hollow fiction remains.

Under the old order, even in bad times for the cobbler there was some work at his bench. But under the new order, when the factory shuts down there is no work at all. The perils of cyclic unemployment are greater than ever. To them have been added the perils of technological unemployment. Both have made for economic instability and uncertainty. Associated with these factors has been the mobility of industry itself as it has sought to adjust itself to pressures of changing circumstances.

It is time to recognize that changing conditions of life are making ever-increasing numbers of American families want to rent their homes rather than to buy them. As business men, too, we should recognize that there has been in the past no adequate recognition of the fact, and little effort to satisfy this tremendous potential market. One reason that so many American families have bought homes, often jerrybuilt homes from speculators, has been because there was no decent alternative. Home rental has not been attractive. For the most part landlordism has been absentee or amateur. Both landlords and property managers have regarded, and too generally still regard, their rented properties as mines to exploit rather than as farms to maintain and improve.

The present situation offers to the American construction industry, the savings institution and management an opportunity to build a new kind of blight-proof residential community to be managed on a long-term investment basis. The only grief of limited-dividend companies, insofar as I have been able to learn, has come from operations too small-scale or

from speculative procedures apparently inescapable in installment selling. Where these companies have treated their properties as investments and have continued to operate them on a long-term investment basis they have been uniformly successful.

The opportunity for American business to get housing under way quickly is at hand. This opportunity rises from new needs and new wants which have sprung from new conditions of living in America. There are still many families who will want to own their own homes, but the number of families who do not want to buy and who would flock to a properly planned rental subdivision is countless.

Protect Neighborhoods

by HARLAND BARTHOLOMEW

City Planning Consultant, St. Louis

One important reason for the failure of residential construction to regain predepression levels is the heavy loss in values in residential investments resulting from the present instability of city development. Families are reluctant to invest a large portion of their funds in homes when they see such investments by others almost completely destroyed by successive shifts in population. There are great sections of residential development where insurance companies will no longer consider making loans, and the situation is becoming progressively worse.

Only in a few suburban areas where there are stringent zoning ordinances is residential investment reasonably safe from rapid depreciation. The zoning ordinances of our large cities are so general and afford so little true protection to residential investment that they discourage residential building. We need some basis for sounder development, not merely a revision of zoning ordinances but a positive influence instead of the more or less negative effect of zoning. Organization of neighborhoods within large cities would encourage a form of protection similar to that afforded by home owners' associations normally established in the better residential subdivisions.

Unless we can improve the environments of existing residential areas and unless we can give assurance of maintenance of a high standard of environment in newly developed areas, our prospect for a large increase in residential construction and in home ownership is severely handicapped.

Housing to Replace Slums

by NATHAN STRAUS

Administrator, U. S. Housing Authority, Washington, D. C.

The United States is the most backward country in the civilized world in providing decent housing. We have piled up an appalling number of slums; we are today confronted by one of the gravest housing shortages in our history. The building industry still lags behind. Residential construction this year has been far less than our current needs. The wise projection of a housing program offers almost unlimited possibilities in quickening the rate and widening the scope of general economic recovery.

My concern is with rehousing the dwellers in the slums. Under the act which I am administering a slum is defined as "any area where dwellings predominate which, by reason of dilapidation, overcrowding, faulty arrangement or design, lack of ventilation, light or sanitary facilities, or any combination of these factors, is detrimental to safety, health or morals." Your hard business sense tells you that crime, disease and revolt against society are bred in the slums. Enlightened self-interest decides that we declare our determination to end the slums. Slums must go or the society that tolerates them will.

Why not let private industry do it? There is only one answer: Because it cannot. The figures are very simple. Families living in the slums pay rentals of from $4 to $7 per room per month, or from $15 to $25 per apartment or house. The actual cost of operation of a large-scale project, if heating is included, runs from $5 to $6 per room per month. Thus the actual cost of operating decent houses, with no allowance for taxes, interest or amortization, is about equal to the rent that slum families can pay. The figures are not pleasant, but I can assure you that they are essentially accurate. So private industry cannot profitably today rehouse slum dwellers in decent homes.

No competition with private industry is contemplated or, if I read the law aright, is even possible under the Housing Act. The average homebuilding in this country in the years from 1920 to 1929 was 677,000 dwelling units per year; a minimum of 400,000 living units is needed annually to meet the current needs. The funds provided under the Housing Act will produce a maximum of 40,000 living units per year, or only 10 per cent of our national needs, and public housing will serve only those very low-income groups who are not in the market for private housebuilding.

The housing built under the act will be minimal housing—homes that are clean and decent and sunny, but homes built to standards set at the minimum compatible with decency and comfort. We want to use our funds not to house a few families in ideal homes but to house as many slum dwellers as possible decently.

With the inauguration of the government low-cost housing program the United States for the first time will take its place among those nations which have resolved as a matter of national self-respect to end the slums. This is not a temporary program; it is not an emergency program. It is not even an unemployment-relief program, although it will be a great stimulus to employment. Under it we will be able to provide, I hope, decent homes for at least 100,000 families of minimum income. If we can do even that in the next three years we will have taken one step, and not a small one, toward making America a better place to live tomorrow.

Help for Rental Building

by STEWART MCDONALD

Administrator, Federal Housing Administration, Washington, D. C.

A great mass of our population must perforce be renters. It is estimated that perhaps one-half of the entire urban population of the country will always remain renters. Most of these families for various reasons are unable to assume the obligations of home ownership; many must be prepared on short notice to follow employment opportunities to some other part of the country.

It is amazing that this tremendous market in one of our basic industries should stand all but neglected by the business men and investors of this country today, and yet it offers the widest of opportunities and one of

the most fertile fields for promoting general recovery.

During a little more than two years the FHA has placed approximately 250,000 families in individual homes. The individual home-ownership program is well on its way. We are therefore now in a position to intensify our efforts on rental housing.

Apparently there has been a lack of desire on the part of private capital to make permanent investment in dwellings for rental to the great mass of the population. Here is the market that the Federal Housing Administration intends to develop. Section 207 of the National Housing Act authorizes the insurance of mortgages on large-scale housing projects up to $10,000,000 each. By a recent change in our regulations we are also prepared to accept for insurance mortgages on large projects consisting of many single-family houses which may be sold off individually as purchasers appear. In addition and through further amendments to our act we hope soon to be prepared to insure mortgages on any type of project for any number of families, either of row-house or apartment-house type.

Municipal corporations could also develop rental projects eligible for FHA insurance. In all cities are found neighborhoods which have almost been abandoned. In their present state they are useless for homes and cannot produce any appreciable income as business properties. Yet they have all the facilities for proper housing, water, sewerage, light, police and fire protection. In addition they are close in and ideally located for homes of low-salaried office workers, mechanics, watchmen, clerks and the like. Here might be the answer to location for rental housing. The municipal advantages would be great if these areas could be redeveloped by private capital to furnish suitable and proper housing. The first step in any such scheme would be to induce the cities to throw new safeguards around these deserted districts, so that they might be protected as residential areas.

Thus far under our large-scale housing rental program we have actually insured mortgages on 20 projects. They represent a capital outlay of approximately $18,000,000 and have demonstrated their practicability to such an extent that new applications in increasing numbers are now being received.

We in the Federal Housing Administration are prepared to cooperate with private enterprise in developing housing projects in every size up to $10,000,000, and comparable in stability of earnings with such enterprises as Chatham Village, Washington Sanitary Improvement Co. and City and Suburban Homes. Power to insure mortgages can compensate for the concealed risks and hazards. Through our cooperation in the planning, financing, construction and management of the housing corporation we can make it reasonably certain that the project will be economically sound. For the equity investor in such a project there is promise of high degree of stability of return combined with steady appreciation in the value of the investment.

Housing Loans Are Secure

by JOHN H. FAHEY

Chairman, Federal Home Loan Bank Board, Washington, D. C.

We must approach the question of providing better housing primarily from the origin of the needs of the family with an annual income of less than $2,000. And let us remember that the great majority of the urban families of this country have never enjoyed an annual income in excess of $1,500. There is a lot of very useful thought being given to the question of providing a home that does not cost more than $4,000, or even $3,000 to $3,500. But in any event there is an enormous market to which we have not yet given sufficient attention.

The experience of the Home Owners Loan Corp. in making direct loans to home owners in distress is rather illuminating as bearing on the problem of the long-term amortization loan. Before it stopped lending in the summer of 1936 the corporation had closed just a little short of 1,100,000 loans and had loaned a total of $3,100,000,000. Here were over a million loans which on the average were more than two years in default—loans that were lost and gone. These homes were in process of foreclosure. As of last night, as of the close of any business day, the corporation has received from 85 to 87 per cent of all the cash due it on that day. For eighteen months new delinquencies have been declining steadily and collections have risen.

California and some of the other states in that group were among the worst problems when the HOLC came into existence. September and October in that area showed the highest percentage of collections to current billings ever shown in that region. For October in those nine states collections were 113½ per cent of current billings, and in the state of Washington, which has been one of the toughest problems with which we have had to deal, the collections for the month of October were 124 per cent of current billings, the highest of any state in the union. Not only that, but these two months showed a more consistent demand for properties which we had on hand and at higher prices than any two months in the history of the corporation's operation. In the country as a whole, for the last month for which the whole figures are in, our average collections to current billings were just under 109 per cent.

It seems to me that it is a fair deduction from these facts that if bad loans, loans that were lost, that no private interest would think of taking, can turn out as well as the HOLC loans are turning out, there is not much risk to private capital in making long-term loans at reasonable rates of interest on new construction in the face of the obvious shortage of housing which exists today. Unless the law of supply and demand has been repealed, nothing can prevent pressure of demand in this country for additional housing. There is no escape from the fact that you are actually short today at least 1,600,000 residential units. The problem is not restricted to the areas of congested population, for in normal times almost half of all the houses built in this country from year to year were in communities of less than 25,000.

I think it is time that the business of the country should get off of relief itself so far as the government is concerned. This government has been doing things in many directions to encourage housing; but the business and the financial interests of the country have not taken advantage of the opportunities. So far as need of housing is concerned, we have largely taken it out in talk. After all, let us remember that here in the United States of America we have the greatest single developed piece of real estate on the face of the globe. So far as the development of the United States is concerned we have scarcely begun.

Long Culvert Built by Jacking

by JOHN SCOTZIN

State Department of Highways, Harrisburg, Pa.

Working procedure in jacking a 3-ft. pipe culvert 210 ft. through a 66-ft. fill

JACKING a 3-ft. pipe 200 ft. through a fill 66-ft deep was recently completed by the engineers of the Pennsylvania department of highways. In the winter of 1934 when the Perry Highway near Pittsburgh, Pa., was constructed a 66-ft. fill was made over a rather narrow draw. To pass the small stream which trickled down this draw a 36-in. pipe was installed, and because of the depth of the fill, special-heavy cast-iron water pipe was used. Just after the work was completed this pipe collapsed near the middle of the fill, shutting off the flow of water.

The highway department engineers called for bids to replace the pipe but the only bid received was based on tunneling and as it appeared that some other method might secure the results at a lower cost, the bid was rejected. It was then considered whether a 36-in. pipe could be jacked under the fill. The department engineers felt that as the fill had been made in 4-in. layers the possibility of running into a heavy rock was small. Investigation showed that no jacking jobs on record exceeded 120 ft. in length and none was at such depth as 66 ft., but as the fill had been in place over a year and had full settlement, it was calculated that the pressure would not be too great for jacking.

Based on this reasoning a pipe-jacking operation was decided on. Bids on 8-gage corrugated pipe were taken and the pipe company advised the use of corrugated slip plates for the top and the bottom, with the corrugation running parallel to the line of pipe. The pipe was supplied in 10-ft. lengths with spreaders so that the lengths could be lapped and bolted together, the slip plates then being bolted on top and bottom. These slip plates were 16-gage corrugated metal and, due to the corrugations, were somewhat difficult to install. There appears no reason why smooth slip plates would not be just as effective and they would be much easier to install. Two 50-ton jacks having a 24-in. stroke to avoid frequent changing of the blocking were purchased. The weight of the jacks was 310 lb. each, but as long as they were not to be moved this was not inconvenient.

Swamp ground drained

Preliminary work consisted of ditching the water away from the swampy ground at the outlet end of the new location. The bottom of the draw had been a swamp for many years and the soil had very little bearing power. The immediate problem was to secure a backing to take the thrust of 50-ton jacks. After drainage and a fill of dry material on the floor of the draw, it was estimated that a horizontal pressure of 1 ton per sq.ft. could be exerted. Two mats of 6x12 in. timbers, each having a bearing area of 50 sq.ft. were buried and two 14x14 in. jacking posts were placed so that the thrust was equalized between the mats as shown by the accompanying sketch.

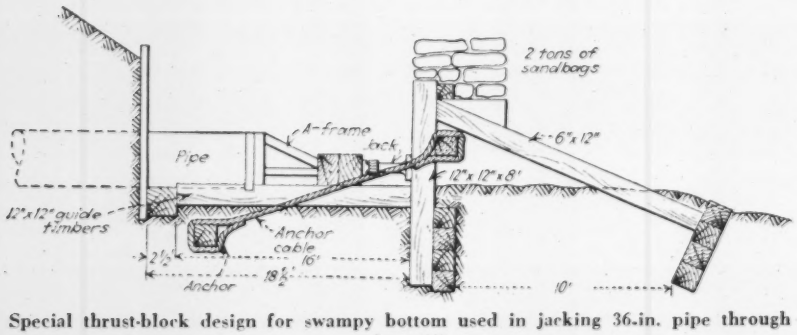
To guide the pipe, timbers armored with steel angles on the inside were set at the entrance; they were 16 ft. long and fell 2 ft. short of reaching the portal so as to provide a pit for access to the bottom of the pipe for bolting on additional joints. A shed was built over the jacking outfit so that work could be continued rain, shine or cold. A careful survey was made and permanent stakes placed on the line and grade desired.

Jacking begun at outlet

The jacking operation was started from the outlet end of the pipe on the up-grade, so that any water pockets in the fill would drain out of the pipe by gravity. It was not known whether sufficient pressure could be exerted from one end of the pipe to push it through the fill or whether the pipe must be pushed through half way from one end and half way from the other end, but it was decided to make a start and go as far as possible and then, if necessary, work from the other end.

The elements of pipe jacking are simple. They consist of cutting out the earth from 1 to 2 ft. in front of the pipe, so that the hole is 1 to 2 in. larger in diameter than the pipe. Then the pipe is jacked up to the face of the cut.

Three sets of miners worked in 8-hr. shifts, each miner working 30 min. at a time and then having a 30-min. rest. In this way more continuous operation was obtained. As a 36-in. pipe is a rather small space in which to work, shovels and picks were cut down to 18 in. in length, and after the pipe had entered a sufficient distance to require air, compressed air spades were used. A track of grooved 2x4 in. timbers was laid in the bottom of the pipe, and a boy's wagon, 18x36 in. was purchased and two boxes made to fit in the body. The wagon was pulled



Special thrust-block design for swampy bottom used in jacking 36-in. pipe through a deep fill.

in and out very easily and the boxes were easily handled to the dump.

Comment on practice

The sketch shows the setup of jacks and blocks. The use of a steel plate on the jacking ring is essential and the A-frame used to transfer the pressure equally to the jacking ring works very successfully. A few large stones were encountered in the fill and were removed very easily. Indeed, after the experience gained in this operation, it is thought that a large boulder could be drilled and shot down in front of a pipe and removed in small pieces without stopping the operation. However, if a large stump were encountered, the problem of reducing it to small enough size to bring it through the pipe might be difficult. The biggest difficulty was in keeping the jacking posts in the ground. Due to a slight error in calculating the stresses the posts had a tendency to work out, which was finally overcome by placing a deadman some distance in front of the posts and piling 2 tons of sand bags on top of them.

The pipe broke through at the inlet end within several inches of line and grade. The entire operation was handled in winter and the average progress was about 10 ft. of pipe per day. The average cost of the job was $24.51 per foot, divided as follows:

Cost of getting material on job and erecting bulkhead	$267 80
Cost of tearing down bulkhead and digging inlet and outlet ditch	223 05
Actual supervision and cost of digging and jacking pipe	2,494.31
Total supervision and labor	2,985 16
Garage payroll, including equipment and operators	233 20
Equipment rental (trucks, compressor, etc.)	554 97
Miscellaneous costs (lumber, rope, wagon, lighting fixtures, pulleys, bolts, spreads, angle irons, etc.)	282 58
Total cost of 36 in. pipe 204 ft. long	994.52

New Streets of Grouted Brickbats

by M. H. Small

District Engineer, Portland Cement Association, Kansas City, Mo.

Breaking up old paving brick for aggregate, St. Joseph, Mo., is getting new cement macadam streets

Confronted with the end of a high-class paving program due to curtailed PWA funds, the city of St. Joseph, Mo., is meeting a need and a popular demand for better streets by laying cement-bound, broken-brick pavements. In this work the city, the property owners and the Works Progress Administration have joined forces with unusual enthusiasm; the property owners in fact are crowding the city and WPA authorities to keep pace now that the program has got to a start. It began with the abandonment of street railway track and the installation of bus lines on several streets.

The city officials were anxious to remove the tracks as they presented a hazard and otherwise restricted traffic, and the WPA needed labor projects in the city; WPA track-removal and paving projects were planned and sponsored by the city. The first was 27th St. between Mitchell and Duncan streets which had a brick pavement on a sand base on which heavy bus traffic was causing high maintenance. The city engineer, C. O. Judson, decided to pave the track section of the four blocks, Mitchell to Duncan, with crushed-brick cement-bound macadam. The street car tracks and the brick pavement were removed from the center of the street to a width of about 9 ft. and the ties were left in place undisturbed.

A small portable crusher was used at first to break up the brick to the desired gradation of 1½ to 2½ in. but this operation proved unsatisfactory due to the costs of handling and hauling. The use of the crusher was discontinued and the brick was stockpiled along the street, adjacent to the point of use, and broken up by hand. Closer control of gradation was found possible by the use of hand breaking.

Construction begun in winter

The first block of course aggregate was in place and grouting began on Feb. 19, 1937, with a temperature of 35 deg. F. The cement-sand grout was proportioned 1:2½ by weight and deposited at a temperature of 70 deg. F. or higher. The 7-cu.ft. mixer was equipped with a drum heater and the mixing water was heated by coils in the tank to which the mixer engine exhaust was connected. The mixer had a long discharge spout with a perforated distribution head which broke up the force of the grout as it was deposited and prevented segregation. Construction methods and

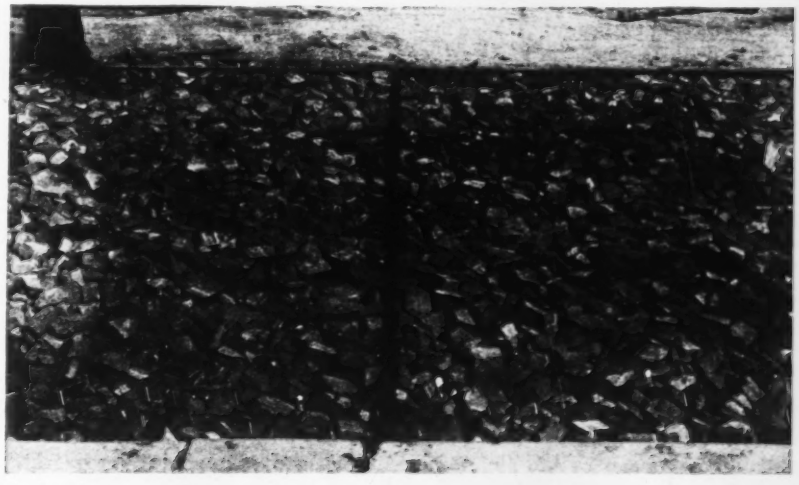


Fig. 1. Brick broken by hand was laid between forms, with expansion joints in place, compacted and brought to profile before grouting.

penetration of the grout mixture were under the constant supervision of an inspector.

The initial and final compaction of the brick aggregate was done by hand and excellent penetration was obtained. During grouting, fluidity was checked several times each hour by the use of a flow cone. Finishing operations followed the grouting very closely: A transverse tamping template was followed by long-handled floats, and a burlap drag for final finishing operation gave the concrete a gritty texture.

Expansion joints, placed every 50 ft. were formed by a 1-in. board which was pulled when the pavement had hardened sufficiently and the joint was later filled with hot tar. Curing was with wet burlap and straw and the pavement was closed to traffic for 13 days.

Fig. 2. Proper liquidity of the grout was tested frequently by flow cone equipment, as is shown here.

High-early-strength cement was used and the temperature ranged from 20 to 60 deg. F. Test beams were made and the 3-day break showed a modulus of rupture of 340 lb. per sq. in.

City officials and property owners were well pleased with the results and petitions were circulated at once to have the strips on each side of the new center lane torn out and paved.

Other broken brick cement bound macadam projects went forward upon the completion of the first and as the WPA crews were familiar with the operations better efficiencies were realized. The construction methods were about the same except that a 3-ton roller was used for both the initial and final compaction. The use of the 3-ton roller allowed full penetration and cut the cement factor to 1 20 bbl. per cu.yd.

Sewage Sludge as Fertilizer

A.P.H.A. committee report summarizes available data, and concludes that sludge may have a definite place in soil fertilization

SUMMARIZING practice in the utilization of sludge for fertilizing purposes, the report of the committee of sewage disposal at the recent meeting of the American Public Health Association, focuses attention on the possibility of wider use of this material. Stating that sewage sludge may fill a definite place in the field of soil fertilization primarily because of its nitrogen and humus content, and secondly because of such phosphorus, potash or lime as it may contain, the committee pointed out that it may also be of value as a conditioner or base in mixing commercial fertilizers. The following is an abstract of this report.

In general, sludges may be divided into four classes, namely, (1) settled (also called fresh); (2) digested (after settling); (3) activated; (4) digested activated. Sludge may be obtained directly from raw sewage and undergo any one of the above four treatments, or it may be precipitated from the sewage with the aid of various chemicals, and then pass through any one of the four treatments. Further, when trickling filters are used, a secondary sludge or "humus" is obtained from sedimentation of the filter effluent; this sludge is generally mixed with the primary sludge and passed through a given treatment.

Fertilizing values

Although there is a considerable variation in the fertilizing value of sludges produced by various processes, data collected from 417 sewage plants clearly point to a higher nitrogen content in the heat-dried activated sludge than in the other types, raw or digested. Comparatively few data are available on the nitrogen content of fresh sludge; at Chicago fresh sludge removed from settling tanks showed a nitrogen content ranging from 1.2 to 3.0 per cent on a dry basis, and averaging 1.9 over three years. Analyses from the Indianapolis Sanitary District show that at this place primary sludge is lower in total organic nitrogen and higher in other solubles than the activated sludge.

Data on fertilizer constituents of Texas sewage sludges show that digested sludge contains from 0.55 to 2.99 per cent of nitrogen, with an average of 2.09 per cent. The total phosphoric acid varies from 0.47 to 3.74 per cent, and averages 1.63 per cent.

Reporting the findings of one investigator, it was stated that based on percentage content of fertilizer constitutents, their relative availability, and the physical nature of the material, digested sludge is somewhat comparable to farm manure. "The most important differences in the two materials are that the more easily decomposible nitrogen compounds of the sludge have been more completely removed by the digestion process than is the case with manure, leaving a nitrogenous residue of lower availability, and that the potash, being mostly water-soluble, has been

largely washed out of the sludge, while it is retained in the manure."

Grease removal important

In the past, particularly before the digestion of sewage sludges was commonly practiced or well understood, sludge was applied to fields in a wet form, or in a filter cake, with its original or fresh grease content. This sludge often proved difficult for the soil to absorb. The digestion and the activated sludge process, however, with few exceptions appear to reduce the ether soluble content below a point which is objectionable to the agriculturist. In general, ether soluble matter of animal or vegetable origin as found in sewage sludge does not appear objectionable; oils or greases of mineral origin, however, may prove troublesome.

Summary of conclusions

From the vast amount of data assembled by the committee, the following conclusions were reached:

Sewage sludge is of use as a fertilizer, if properly prepared and applied. Its value varies with the type.

Fresh sludge is seldom used and may be troublesome because of grease content, odors and bacteria present.

Digested sludge, whether wet, air-dried or heat-dried appears to have use as a substitute for manure and is of about the same fertilizing value. In its wet form it must be used relatively close to the sewage works. In its air-dried form it may be worth while to transport it a short distance, perhaps 20 miles more or less. In its heat-dried form with a sufficient nitrogen content, it may justify a considerable haul. The nitrogen content however is relatively low (0.5—3 per cent dry basis) as compared with heat-dried activated sludge (3—6 per cent dry basis).

Activated sludge, heat-dried, appears to have real value as a source of organic nitrogen fertilizer, whether used directly or in mixtures. It is free from weed seeds, blends quickly with the soil. When applied to the soil it has a slight odor for a very short period. It can be used with safety in fertilizing practically all crops requiring nitrogen in organic form.

Sewage works offering digested sludge are scattered all over the United States. The air-dried sludge is most commonly used locally within an easy distance of truck haul. Most of the works give away this sludge. Many load it free of charge.

Air-dried digested sludge should preferably be disintegrated or ground to remove lumps before distributing for use. When so prepared a charge is usually made in addition to a charge for bags.

Both wet and air-dried digested sludge should be handled like manure and plowed under as soon as practicable after distribution.

Heat-dried digested sludge was prepared in 1937 at only 3 plants, Dayton, O., Rockford, Ill., and Plainfield, N. J. Years ago at Baltimore a contractor abandoned heat drying of air-dried digested sludge because it was financially unsuccessful. Fire has temporarily interrupted marketing at Grand Rapids, but the heat drying plant is being rebuilt; part of the Rockford plant also burned down recently. It appears that the success of heat-dried digested sludge depends on such conditions as soil type and crops, and on the effort and skill of the sewage works manager in exploiting the product, as well as on the analysis. The cost of equipment and operation are a bar to heat-drying in small works.

Enriching heat-dried digested sludge with suitable chemicals has been practiced at Rockford, Ill., but not on the entire sludge output. This appears to have been done for a particular buyer for sale in competition with heat-dried activated sludge.

Digested activated sludge apparently falls into the digested sludge classification when judged by its analysis and use.

Dried activated sludge

Heat-dried activated sludge appears to have a ready market at the present time, which the plants at Milwaukee, Pasadena and Houston are unable to satisfy. This type of sludge is sold retail in bags and wholesale in bulk at a somewhat lower price. Quotations are determined by the market price of its content of organic nitrogen and phosphoric acid.

Heat-dried activated sludge is of value in the fertilizer and agricultural field for its organic nitrogen and phosphoric acid content as well as humus, and its effect as a conditioner in mixed fertilizers. As such, with suitable nitrogen content, it may justify a rail haul of 1,000 miles more or less. Where organic nitrogen is required, heat-dried activated sludge can be used with safety at any reasonable time.

The cost of dewatering and heat-drying activated sludge on a small scale appears to have deterred those in charge of the smaller works from following this practice.

With the exception of the southern California citrus orchards, no organized handling of air-dried digested sludge from a number of adjacent plants has been found. However, a large number of plants, both large and small, have developed a market for their entire output. There is no uniformity of charge and success in disposing of the sludge. In many small plants a knowledge of the uses for sludge appears lacking, although a number of operators would like information.

Heat-dried activated sludge is the least odorous and fresh sludge the most odorous of the various sludges. The degree of odor from digested sludge may depend on the completeness of digestion. It is therefore desirable that all air dried or fresh sludge be turned into the soil as promptly as possible.

Hygienic considerations

From the hygienic standpoint, heat-dried activated sludge and heat-dried digested sludge appear safe for any reasonable use in agriculture or horticulture. Digested sludge, air-dried, appears safe for such purposes if used like manure and plowed in, when preparing for a crop, and if care is taken not to apply such sludge thereafter on root crops or lowlying leafy vegetables which are eaten uncooked. Thorough digestion and air-drying, as well as storage of the air-dried sludge afford a sufficient protection. The committee knows of no case of sickness traceable to the use of digested or activated sludge.

Fresh sludge should be regarded as only one degree removed from night soil and treated as such, being used only on forage crops and then applied and plowed in promptly.

The members of the committee on sewage disposal of the American Public Health Association are: Langdon Pearse, Chairman; C. K. Calvert, Almon L. Fales, C. G. Gillespie, C. E. Keefer, T. J. Lafreniere, F. W. Mohlman, Willem Rudolfs, F. M. Veatch, P. J. A. Zeller.

Zoning the Great Plains Proposed as a Drought Measure

Abstract of an address by John C. Page before the Nebraska Historical Society

IN TIMES OF DROUGHT, with the heart-breaking lesson of disaster before us, we turn more thoughtfully to consideration of our water problems. Memory is short, however, and a general break in the weather often intercedes before solutions are found and executed.

The Great Plains are neither humid nor arid continuously, but alternately, are either humid or arid as nature decrees. The 100th meridian, which splits Nebraska in two, running down between Grand Island and North Platte, is the line which divides the humid from the arid. If the rainfall did not vary from year to year and seemingly run in cycles, either wet or dry, it is probable that little or no land west of the 100th meridian would have been plowed except that which could have been provided in advance with a reliable irrigation water supply.

But the rain is beyond human control and nature is inconstant. She sends her clouds where and when she pleases. We can say definitely about her methods that, over a long period of years, the average rainfall will not be different from that received over any other long period of years. It is safe also to say that where a flood has occurred another flood will come and where a drought has occurred another may be expected.

Rain insufficient for crops

Reliable records show that the average annual rainfall, generally, west of the 100th meridian is below 20 in. a year, insufficient for safe farming. In 1889, Major John Wesley Powell, director of the United States Geological Survey, stood before the North Dakota Constitutional Convention, earnestly pleading that title to the flowing waters of the state be retained for the people. He pointed to the curious geographical position of the state in relation to agriculture, saying the eastern part would have water for crops, the western part would soon learn to depend on irrigation and that in the central part "they will have a series of years when they will have abundant crops; then for two or three years they will have less rainfall and there will be failure of crops and disaster will come on thousands of people who will become discouraged and will leave. There are waters rolling by you which are quite ample to redeem your land and you must save these waters."

The drought of 1890 had many of the same effects as this of the present time. A notable exception was that the population was less and there were fewer to suffer. But it rained again and even more lands were broken, even more homes were established and even more communities built, so that this, the next great drought, brought greater disaster.

Will this same cycle of more rain and increasing enthusiasm, less rain and mounting human misery, be allowed to repeat itself again? This problem should be approached with courage. The challenge of droughts must be met.

All cities have used the zoning method to protect valuable property and to assure that growth will follow an intelligent plan. This method of restricting unwise expansion and of maintaining the integrity of a well-laid plan for agriculture on a state-wide basis might prove effective if intelligently applied here. Rural zoning in the Great Plains might give the firm control which must be exercised if at some future time another drought is not again to upset the economy and demoralize the populations of these states to even a greater extent.

A state which is one-third arid, one-third humid and one-third in the twilight zone between the two can find no permanent security within itself if it is constantly expanding or painfully contracting in accordance with the whims of nature.

The Bureau of Reclamation now provides and has for nearly 30 years a regulated irrigation water supply from Pathfinder reservoir for 250,000 acres along the North Platte river in western Nebraska. Here live in security nearly 25,000 people on more than 2,000 farms and in about a dozen towns. Despite the drought, these people have not been unprosperous. The value of their crops last year, during the worst of the drought, was about $9,000,000. The even tenor of their production has exerted a powerful stabilizing influence on a vast surrounding area. I am convinced that projects which wisely use the water resources of this region will redound to the benefit of the people of the states and of the nation. If by proper planning now, another generation of homeless can be prevented from developing in the future, should not the necessary steps be taken at once?

Forgot drought recurs

Skeletons of old irrigation works dot the twilight zone of the Great Plains. Some of these failed, because the farmers who were to have been served forgot that drought recurs and refused to keep their water systems in operating condition during wet years. When they were needed, the canals could not be used. Yet since this period of drought set in back in 1929, these abandoned works, if they could have been used, would have saved many times their original cost.

There are undoubtedly in Nebraska underground water resources which safely could be tapped to supplement the natural rainfall in deficient years. Properly regulated by state legislation or perhaps through the rural zoning method so as to prevent overdevelopment and eventual exhaustion of the so-called underground reservoirs, pumping for irrigation of comparatively small plots on the farms in the area most in need of a steadying influence might prove very effective.

Whatever is done must be initiated by the people affected and done with their cooperation. A candid understanding of the situation must precede permanent solution of the problem.

Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

GAS FOR AUTOS—The utilization of sewage gas for automobiles and trucks has been making rapid progress in Germany. In Munich over 100 million cu. ft. of gas are "bottled" for this purpose. Spaeth (*Gesundheits Ingenieur*, 60, 533, 1937) describes the compression and bottling of the gas in cylinders for use in trucks. Each truck carries two or more cylinders which can be filled directly from the compressor mechanism without being removed. Cylinder capacity is about 110 liters, and each contains about 770 cu. ft. of gas. Operating results on dump trucks show that for the highest demands two of the larger cylinders furnished sufficient fuel for traveling about 60 miles; gas consumption, therefore, is at the rate of 25 cu. ft. per mile.

AERATION FORMULAS—Speculation and some experimentation have led to various opinions regarding the oxygen requirements of activated sludge when mixed with sewage. Meantime, evidence regarding the rapidity of oxidation of easily oxidizable substances has been accumulating. The latter has led to methods of aeration whereby decreasing quantities of air are supplied when the mixed liquor flows through the aeration tanks (so-called "tapered" aeration). Experiments conducted by Basjakina in Moscow and summarized by Pohl (*Gesundheits Inginieur*, 60, 610, 1937) now furnish mathematical formulas expressing the rate of oxidation of a definite quantity of sewage in the presence of a given amount of air.

The quantity of air used by the sludge itself is small, amounting to about half a milligram oxygen per gram of dry sludge. Changes in the degree of oxidation can be calculated, but changes in the composition of the purified sewage do not indicate oxidation phenomena alone. The amount of aeration required for the sewage initially is proportional to the concentration of sewage. This can be easily calculated and the quantity of air thereafter kept sufficient for the later stages of slower oxidation rates.

SLUDGE SCRAPING—There are a number of different mechanisms employed to scrape sludge from the bottom of sedimentation tanks. Experience has shown that under certain conditions some of the deposited sludge might be disturbed by the scrapers with the result that the overlying liquor becomes cloudy or some of the sludge may escape at the outlet. There difficulties are accentuated when the settled sludge is light and fluffy, or the tanks are large. To prevent light sludge deposited in the outer zones of a settling tank to be stirred up when pushed over the floor for long distances, Prüss (*The Surveyor*, Sept. 10, 1937), utilizes four converging pairs of plows which push the sludge from the outer zone to four air lift pump mouth pieces.

The pumps discharge sludge through a delivery pipe mounted on the bridge of the clarifier to a centre pocket, where it mixes with the heavier sludge from the inner zone of the clarifier. In practice, these plows work only for one revolution in each shift, the speed of revolution being reduced for this purpose so that it takes 96 min. They are then lifted out of the water for 6 hr. while scraping of the inner zone proceeds at three revolutions per hr. The sedimentation installation takes care of over 200 m.g.d. of sewage, and produces about 250,000 tons of sludge a year from a million people served.

DAIRY WASTES—Biological methods for the treatment of dairy wastes vary from disposal on land to the activated sludge process. Recently, considerable progress has been made with disposal on filters. Jenkins (*The Surveyor*, 91, 463, 1937), passed a mixture of 1 per cent milk through a copious growth on a lath filter, and the effluent was satisfactorily treated on a gravel bed. Crude milk washings are amenable to treatment by a process of double filtration. It is significant that better effluents have been obtained by aeration of strong crude liquids for a longer period than by the treatment of weaker liquids for a correspondingly shorter time. Double filtration gave satisfactory results continuously under varying conditions and withstood occasional treatment with very strong liquid.

Studies by Muers (*Jour.* Society Chemical Ind. 55, 71) indicate that trickling filters fed with a 10 per cent solution of whey applied at a rate of 50 gallons per cu.yd. per day produce a reduction of 90-95 per cent in B.O.D. Neither replacing a part of the whey by skim milk nor decreasing the carbon-nitrogen ratio by the addition of ammonia carbonate or sodium nitrate have any adverse effect. A second biological filtration was relatively ineffective.

AERATION TANK DESIGN—Laboratory and plant experiments have shown that there is a rather definite relation between the quantity of dry suspended solids in the sewage at a given place and the amount of dry activated sludge to be returned to obtain best and most economical results. If this relationship is kept constant, the quantity of air to be supplied will vary with the concentration and type of sewage and sludge handled. At many plants the volume of sludge is returned on a percentage basis in an effort to keep the concentration of the mixed liquor at a pre-determined value.

Taking operating results from some large plants, Freese (*Proc.* Am. Soc. C. E., Oct. 1937), has attempted to construct a curve to arrive at a practical guide to be used in approximating the detention period and percentages of return sludge to be provided for in the design of aeration tanks. His curve, which applies to sewage without undue quantities of waste with high biochemical oxygen demand, indicates that the aeration period and percentage return sludge is largely proportional to the strength of the sewage. Although the curve is admittedly only an approximation, it serves as a valuable aid for designing engineers when the character of the sewage is known.

THE WEEK'S EVENTS

(Continued from page 883)

Appraisers Study Trend In Property Values

Long range social factors affecting the value of property and the importance of broader data for adequate appraisal were subjects given attention at the first meeting of the National Appraisal Forum, held in Washington, Nov. 19-20. It is expected that the gathering, which was sponsored by the Joint Committee on Appraisal and Mortgage Analysis, a subdivision of the Central Housing Committee, will be an annual event. The Central Housing Committee is composed of representatives of about 28 federal agencies concerned with housing problems.

H. O. Walther, past president and governor of the Society of Residential Appraisers, said that not enough sociological data are available on the environment of properties evaluated. He listed important sociological facts as the habits of the people in specific neighborhoods with regard to respect for law, civic interest, desire to stay put, tendency to large or small families, and trustworthiness. The data on which real property is evaluated must extend over a longer period than is necessary in valuing other articles with a shorter economic life, Ernest M. Fisher, director of the Division of Economic Statistics of FHA, told the appraisers. He urged them to begin now to develop records which will make it possible for appraisers in the future to have an increasingly long range perspective.

Sources of appraisal data in smaller communities were suggested by Paul Hathaway of Denver, who mentioned telephone companies, school districts and chain stores as having good estimates on future trends. Leonard Downie told of the uses to which broad data could be put, pointing out as an example the need to know what effect the development of parking meters will have on the value of parking lots.

The importance of local data was again pointed out by David T. Roland, who suggested that the real estate cycle may be a local rather than a national phenomenon. He said there is a tendency to rely too much on government agencies to supply data which could better come from local sources.

Secretary of Commerce Roper, welcoming the conferees to Washington, cited statistics on the need for housing. Donald H. McNeal, technical director of the Federal Home Loan Bank Board, said that appraisers should assemble data which would bring out information concerning developments and trends in the use of mechanical equipment and the better organization of field fabrication in the construction industry.

• • •

Texas Truck-Weight Law To Be Attacked

Constitutionality of a Texas law limiting the loadweight of trucks to 7,000 lb. will be attacked in the courts in a suit which is now being prepared by the Texas Motor Transportation Association in cooperation with the American Trucking Association. The law has previously been upheld in several cases brought by individual operators, one of which reached the U. S. Supreme Court, but the association contends that the real questions at issue were not involved in or passed upon in any of the cases so far before the court.

The proposed suit will be based on the contention that the state law is a barrier to interstate commerce and that it is also an obstacle to the granting of federal aid for construction of highways, it was stated at the office of the Texas Motor Transportation Association in Austin.

The American Trucking Association has been engaged for some time past in testing the constitutionality of various state laws throughout the country limiting the weight of trucks. A case attacking the Florida law, which limits gross weight of trucks to 20,000 lb., is now pending in the U. S. Supreme Court. In Kentucky a case has been filed contesting a law fixing the gross weight at 18,000 lb., and a similar case is pending in Tennessee.

The Texas case, like these others, will be conducted by attorneys for the American Trucking Association, and expenses will be paid by the Texas Motor Transportation Association.

• • •

Germans Limit Driving

Drivers making use of Germany's new system of express highways will not be permitted to drive for longer than eight hours at a stretch without rest, it has been announced by the Reich Highways Commissioner.

Plan for Suburban Area Developed in Maryland

A general plan for the development of the suburban area between Baltimore and Washington, cities which are spreading toward each other at the rate of about 4 sq.mi. per year, was made public Nov. 21 by the Maryland State Planning Commission.

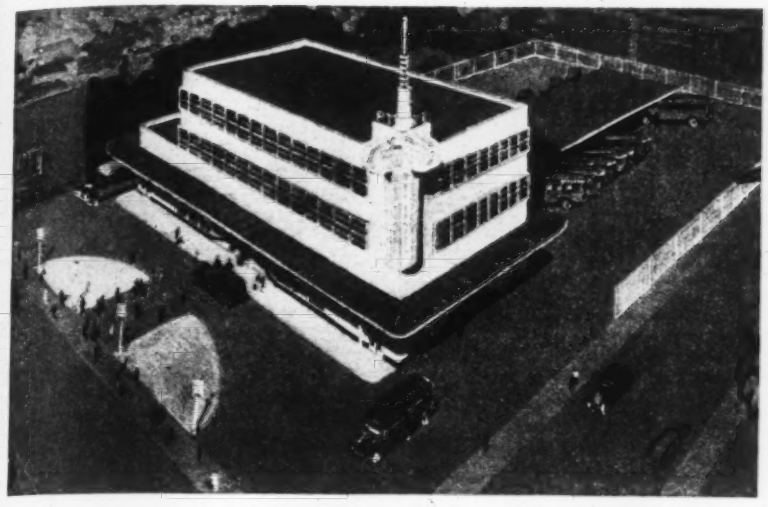
Working on the assumption that 80,000 people and 40 sq.mi. of suburbs will be added to the area by 1950, the commission suggests that the form of growth consist of suburban communities separated by intervening open space. The character of this growth should be regulated by subdivision control, zoning, building codes, and provision for open space to prevent overdevelopment of the area.

Commenting on the report, Abel Wolman, chairman of the Maryland State Planning Commission, said, "The area is not a region in the sense of being a natural geographic unit. . . . It can be viewed as a logical unit for planning only because of the dominant influence of Baltimore and Washington. . . . The non-urban portion is frankly considered in relation to the growth of these cities."

Immediate construction of two new parkways between Washington and Baltimore and Washington and Annapolis is recommended in the report, and in addition a coastal parkway is urged from Annapolis to Solomon's Island. Regulation to insure orderly conversion of farms to residences and provide adequate open space is suggested for the Piedmont section northwest of the Baltimore-Washington Boulevard.

The commission recommends that as much as 100,000 acres of land in the coastal section of the area be acquired by state or federal agencies as well as a number of beaches along Chesapeake Bay. The coastal section contains about 120,000 acres of poor or eroded farm land, and much of this could better be used, the commission holds, for purposes of forest management, recreation and wild life readjustment.

In order to permit orderly development of this area, the commission recommends state legislation to extend the jurisdiction of the Maryland National Capital Park and Planning Commission and the Annapolis Planning Commission and to establish a Baltimore Metropolitan Commission so that these agencies, in connection with other existing planning agencies, would cover the whole area in question. A coordinating committee should be established, sponsored by the Maryland State Planning Commission, to assume responsibility for coordinating area-wide planning proposals.



BUS TERMINAL FOR MONTREAL

ABANDONMENT of one of Montreal's churches has permitted acquisition of an unusually well located site, from the point of view of traffic, for this new bus terminal in Montreal, on which construction is expected to start shortly. The station will be built in the central part of the city by Provincial Transport, Ltd., a local bus-operating company, and will be used by long distance and local bus lines.

The building will be a three-story steel and concrete structure with exterior walls of brick faced with white cement. Fifty-three feet by 110 ft. in plan, it will be surrounded by a large circulating and traffic area to serve automobiles and buses.

Also recommended is state enabling legislation which would give local communities in the area more adequate authority to enforce planning agency recommendations by local laws.

Finally, it is believed that the coordinating committee should prepare a fiscal program for a definite 10-year period indicating priority for various projects and proportions of funds to be furnished by local, state, and federal agencies.

• • •

Clas Resigns from PWA

A. R. Clas has resigned his position as assistant administrator of PWA in charge of investigations to resume private business. Mr. Clas, in his letter of resignation, pointed out that great reduction in the personnel of the investigation staff has been effected and that further reduction will be accomplished before Nov. 30, when the resignation becomes effective, and said that he considered his job finished.

Mr. Clas, a graduate of Harvard Architectural School, had been in business as a manufacturer and had practiced architecture in Chicago before assuming the position in May, 1934, of assistant director of the PWA Housing Division. He became director of the Housing Division in July, 1935, and a year later he was appointed to the position from which he is now resigning.

Commercial Testing Labs Form Organization

Representatives of twenty commercial laboratories organized the American Council of Commercial Laboratories at a recent meeting in Chicago. Membership in the new organization, a principal purpose of which will be the promotion of the proper use of scientific testing methods, will be restricted to independent laboratories engaging in research and testing for fees. Laboratories which are adjuncts of other enterprises or which are not self-supporting or which, for any reason, are not independent are ineligible for membership in the council. Laboratories working in a wide range of subjects have already joined the council.

The following officers have been elected to serve during 1938: President, Preston S. Miller, Electrical Testing Laboratories, New York, N. Y.; vice-president, Monroe L. Patzig, Patzig Testing Laboratories, Des Moines, Iowa; secretary, D. E. Douty, United States Testing Co., Hoboken, N. J.; treasurer, A. R. Ellis, Pittsburgh Testing Laboratory, Pittsburgh, Pa. The executive committee, which will also serve during 1938, is composed of the following: James H. Herron, the James H. Herron Co., Cleveland, Ohio; F. B. Porter, Southwestern Laboratories, Fort Worth, Texas; and T. A. Wright, Lucius Pitkin, Inc., New York, N. Y.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

THE ASPHALT INSTITUTE, national asphalt conference, Memphis, Dec. 6-13.

ASSOCIATION OF ASPHALT PAVING TECHNOLOGISTS, annual meeting, Memphis, Dec. 6-11.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Netherlands Plaza Hotel, Cincinnati, Jan. 12-14.

AMERICAN ENGINEERING COUNCIL, annual convention, Washington, D. C., Mayflower Hotel, Jan. 13-15.

SECRETARIES OF ENGINEERING ORGANIZATIONS, annual conference, Washington, D. C., Mayflower Hotel, Jan. 13-15.

AMERICAN ROAD BUILDERS ASSOCIATION, road show and convention, Cleveland, Jan. 17-21.

AMERICAN WOOD PRESERVERS ASSOCIATION, annual meeting, Chicago, Congress Hotel, Jan. 18-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York City, Jan. 19-21.

ENGINEERING INSTITUTE OF CANADA, annual meeting, London, Ont., Jan. 31-Feb. 1.

REGIONAL AND LOCAL

INDIANA SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, Indianapolis, Ind., Dec. 10.

LOUISIANA ENGINEERING SOCIETY, annual meeting, St. Charles Hotel, New Orleans, Jan. 7-8.

NEW JERSEY ASSOCIATION OF PROFESSIONAL ENGINEERS AND LAND SURVEYORS, Elks Club, Jersey City, N. J., Jan. 14-15.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, annual meeting, New York City, Jan. 20-22.

NORTH CAROLINA SOCIETY OF ENGINEERS, Raleigh, annual meeting, Raleigh, Jan. 28-29.

SOUTHWEST ROAD SHOW AND SCHOOL, annual session, Wichita Exhibition Building, Wichita, Kan., Feb. 22-25.

ELECTIONS AND ACTIVITIES

THE GEORGIA Water Works and Sewage Operators Association elected the following officers at a recent meeting: President, Lewis Simonton; vice-presidents, L. L. Jacobs and Clark W. Jones. Paul Weir was re-elected secretary-treasurer. The meeting was held in connection with the sixth annual Georgia water and sewerage school sponsored

by the Georgia department of health, by the association, and by the Georgia School of Technology. Attention was called at the school to the necessity for local water and sewerage officials to have a voice in choosing the location of public housing projects so that they may fit in with the future expected trend of the city's development.

LIFE MEMBERSHIPS in the American Society of Civil Engineers have been awarded to seven members of the Georgia section. The awards, made at a meeting of the section, Nov. 9, went to: Lyle F. Bellinger, Edwin L. Grimes, Leon E. Lyon, Charles M. Strahan, Lea Treadwell, Julian deB. Kops, and T. L. Huston. Messrs. Kops and Huston were unable to receive their awards in person because of illness.

THE NAME of the Detroit Section, American Society of Civil Engineers, was recently changed to the Michigan Section. At the same meeting the following officers were elected: President, R. L. McNamee; vice-presidents, Milo Ohr and Chester L. Allen. L. C. Wilcoxen was re-elected secretary-treasurer.

• • •

License Examinations

Iowa: Examinations for professional engineering Dec. 7-8 and for land surveying Dec. 9 at Des Moines.

• • •

Social Effect of Science Is Meeting Theme

The social effects of science and technology are to be the subject of a series of conferences to be held by the section on engineering at the annual meeting of the American Association for the Advancement of Science. The meeting is to be in Indianapolis Dec. 27-31.

The meeting of the section on engineering, which is being held in cooperation with the Indiana Engineering Council, is to be coordinated with a series of "conferences on science and society" which will be a feature of the A.A.A.S. meeting, under the chairmanship of Charles G. Moulton, president of the Brookings Institute.

Arrangements for attendance are in charge of a committee of the Indiana Engineering Council, of which Homer Rupard is secretary.

• • •

New Structural Courses At Federation School

Two new courses in the analysis of structures have been introduced by the Federation Technical School in New York City. A course of about 45 lectures on the analysis of structures by the method of angular rotation will be taught by Samuel Napp. Also being started is an 8-session lecture and problem course in the use of the Hardy Cross method of analysis, taught by George Kranich.

The Federation School, 116 E. 16th St., is a cooperative technical school sponsored by the Federation of Architects, Engineers, Chemists and Technicians.

PERSONAL

JOHN HEWES, JR., since 1929 transportation assistant of the Baltimore and Ohio R.R. at Pittsburgh, and previously connected with the engineering department of the railroad, has been appointed superintendent of the Newark Division, succeeding Mr. C. C. Stevens, retired. Mr. Hewes joined the railroad staff in 1905 as an axeman in the engineering department. Rising through various positions, he became bridge inspector at Cincinnati in 1914 and the following year became assistant superintendent on the Ohio Division. A year later he was appointed a draftsman in the chief engineer's office, rising rapidly through the ranks of field engineer, assistant engineer, and division engineer. He held this last position for seven years until 1925 when he became assistant superintendent at Akron, remaining there until 1929.

CHARLES E. GREENE, who has been electrical and mechanical engineer for Metcalf and Eddy, Boston, for the past decade, has joined the staff of Cleverdon, Varney & Pike, Boston consulting engineers, in a similar capacity.

GEORGE C. ERNST, formerly of Iowa State College, has been appointed professor of civil engineering at the Engineering College, University of Maryland.

E. C. INGALLS has been appointed an instructor in civil engineering at the University of Maryland Engineering College.

ROBERT E. PARKER, formerly chief engineer for the PWA in New Hampshire, Vermont and Maine, has opened offices in Concord, N. H., to practice as a construction engineer.

• • •

Smoke Commissioner Passes On St. Louis Smokestacks

St. Louis building contractors have had their attention drawn by the building commissioner to a new section of the building ordinance, which provides that all building plans which include the construction of a chimney or smoke stack must be approved by the commissioner of smoke regulation before a permit will be issued.

Commissioner Welch stated that this section of the ordinance would be rigidly enforced.

OBITUARY

HORACE KINGMAN, for 44 years superintendent of the municipal water department of Brockton, Mass., died Nov. 16 at the age of 73.

WILLIAM J. MILLER, a civil engineer in the maintenance of way department division of the Third Ave. Ry. system in New York City, died Nov. 17 in Ossining, N. Y. at the age of 50.

MALCOLM G. TRUMAN, president of the Marsh & Truman Lumber Co. of Chicago, died Nov. 5 while on a business trip in the East. Active in the lumber business in Chicago for 45 years, Mr. Truman was one of the founders and at his death was the vice-president of the National-American Wholesale Lumber Association.

JOHN G. ELLENDT, a civil engineer specializing in concrete structures, died Nov. 13 in Rochester, N. Y., at the age of 58. Mr. Ellendt engaged in his profession in New York City between 1896 and 1909 and thereafter was connected for a number of years with the Rochester contracting firm of Whitmore, Rauber & Vicinus. More recently he had served as commissioner of public works in the city of Fulton, N. Y. Mr. Ellendt was a graduate of Cooper Union and had studied at New York City College.

FRANK M. MARSH, 86, who retired in 1921 from his position as terminal engineer at San Francisco for the Western Pacific R.R., died Nov. 9 at Ontario, Calif. Mr. Marsh started his engineering career at 16 as a rodman on the Sioux City & Pacific R.R. (now part of the Illinois Central), and worked up through various engineering positions from several pioneer roads in the Middle West. He became chief engineer of the Fremont Elkhorn & Missouri Valley R.R. (now part of the Chicago & Northwestern Ry.) in 1898, building 200 miles of that line west and north of Chadron, Nebr. Four years later he went to the Union Pacific and in 1905 he became terminal engineer for the Western Pacific, holding that position until his retirement.

EDGAR J. THOMSON, 60, maintenance supervisor for the state highway department at Everett, Wash., died Nov. 15 at the age of 60. Mr. Thomson was formerly construction engineer in the Seattle street department.

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

FOR the third successive month lower lumber prices are the principal change. Southern Pine prices are 50c. to $1.00 lower in Atlanta and St. Louis; $3.00 to $5.00 lower in Detroit. Two-inch planks are down $1.00 in Kansas City. In Boston, Roofers' North Carolina pine is down $1.00; 2 x 6-in. Spruce is up $2.00; and 2 x 8-in. Long Leaf Pine is $2.00 lower. Fir timber prices are $1.00 lower in Detroit and St. Louis; $1.00 to $3.00 in Kansas City; and $1.00 to $2.00 in New York. One-inch fir planks are off $1.00 in Kansas City and Boston. The Seattle base price on plywood is down, $59.50 per 1,000 sq. ft. for the ¼-in., and $67.90 for the ⅜-in. size.

Cement prices are up 4c. in Atlanta and Birmingham, and 3c. in Cincinnati, due to increased freight rates. Detroit's cement price is 5c. lower. Sand and gravel is 20c. higher in Chicago, and sand is 10c. higher in Philadelphia. Granite paving brick is $5.00 lower in Boston. Higher freight rates add 1c. per cwt. to structural shapes, reinforcing bars and sheet piling in Detroit.

Skilled labor in Atlanta which previously ranged from 40c. to $1.00 for carpenters, $1.00 to $1.25 for structural ironworkers, has closed up this steam with the top rates now prevailing. Chicago ironworkers' rate is up 7 5c. to $1.70 and the St. Louis plasterers' rate is 8c. higher, or $1.58.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT			SAND AND GRAVEL			CRUSHED STONE		CRUSHED SLAG		CONCRETE
	Per bbl., carload lots, including 40c per bbl. for bags, cash discount not included			Per ton, carload lots			Per ton, carload lots		Per ton, carload lots, f.o.b. plant		Ready Mixed 1:2:4, 50 c.y. or more, delivered
	Cloth Bags*a*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.89	$2.62	$2.54	$1.65	$1.75	$1.55	$1.55	$1.65	$1.55	$1.65	$8.90
Baltimore	2.31	2.06	1.86	1.80‡	1.80‡	1.30‡	1.30‡	1.30‡	1.80‡	1.80‡	7.35
Birmingham	2.44	2.19	1.99	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.25*b*	2.00*b*	1.80*b*	1.20	1.20	.80	1.20	1.20	....	....	7.00*m*
Chicago	2.45	2.20	2.05	1.20‡	1.20‡	1.20‡	1.35‡	1.35‡	1.00‡	1.00‡	....
Cincinnati	2.56	2.31	2.05	1.20	1.20	1.30	1.80	1.80	....	....	6.60
Cleveland	2.30	2.05	....	1.40	1.40	1.30	1.60	1.60	1.65	1.65	7.15*i*
Dallas	2.30	2.05	1.85	1.40	1.40	1.05	1.00	1.15	1.84	1.89	7.00
Denver	3.08	2.85	....	1.20	1.40	.90	....	....	....	....	....
Detroit	2.15	1.90	1.65	1.15	1.25	.95	1.50	1.60	1.15‡	1.25‡	6.50
Kansas City	2.55	2.30	2.06	1.85	2.30	1.15	1.85	1.80	....	....	7.90*n*
Los Angeles	2.32	2.12	....	2.00	2.00	1.70	2.00*f*	2.00*f*	....	....	7.60
Minneapolis	2.86	....	2.41	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.15*j*
Montreal	....	....	1.70*c*	.85	.95	1.15‡	1.25‡	1.30‡	....	....	6.50*l*
New Orleans	2.37	2.12	....	1.50	1.50	1.25	....	....	....	....	8.00
New York	2.45‡	2.20‡	....	1.50*de*	1.50*de*	1.00*de*	1.65*de*	1.75*de*	....	....	7.70
Philadelphia	2.55	2.30	2.10	1.55‡	1.65‡	1.35‡	2.00‡	2.05‡	1.00	1.00	8.25*k*
Pittsburgh	2.40	2.15	1.95	1.80‡	1.80‡	2.10‡	2.25‡	2.25‡	1.50	1.50	8.75
St. Louis	2.52	2.27	....	1.50‡	1.50‡	1.50‡	.85*h*	.85*h*	.85*g*	.75*g*	7.50
San Francisco	2.72	2.52	2.20	1.35	1.35	1.35	1.50	1.50	....	....	7.50
Seattle	3.10	2.85	....	1.17*o*	1.17*o*	1.17*o*	1.33*o*	1.33*o*	....	....	7.30*o*

‡Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* Sales tax included. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200 cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more *o* 2% off for cash.

CASH DISCOUNTS, CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice, in Montreal 5% if payment before 15th.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Northampton, Pa.	$1.65	$1.60
Crestmore, Calif.	1.72	....	Iola, Kans.	1.70	1.65	North Birmingham, Ala.	1.75	1.70
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	La Salle, Ill.	1.70	1.65	Richard City, Tenn.	1.85	1.80
Hannibal, Mo.	1.70	1.65	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hudson, N. Y.	1.75	1.70	Mason City, Ia.	1.70	1.65	Universal, Pa.	1.65	1.60
Independence, Kans.	1.70	1.65	Norfolk, Va.	1.70	1.65	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70

LOWER PENINSULA, MICHIGAN. Uniform carload lot cement price established March, 1937.

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS			PAVING ASPHALT		ASPHALT BINDERS—FLUXES		CUTBACK ASPHALT		ROAD OILS	ASPHALT EMULSION	
	Granite per M, lots of 50,000, 4x4x8 in.	Brick per M, 3x4x8¼ in., carload lots	Wood per sq. yd., 3½ in. 16-lb. treat	Per ton, less than 80 penetration, Tank car	Drums	Per gal., 80–300 penetration, Tank car	Drums	Per ton, Tank car	Drums	Per gal., Tank car	Per gal., Tank car	Drums
Atlanta	$75.00	$38.85	$2.25	$18.20*e*	$23.41*e*	$0.0728*e*	$0.1049*e*	$.0768*he*	$.1089*he*	$0.0668*e*	$0.0834	$0.0834
Baltimore	140.00	44.00‡	2.50	15.00	20.00	.06	.085	.07*h*	.10*h*	.....	.....	.....
Birmingham	.....	25.00	.....	19.80	24.80	.0804	.1054	.082*h*	.112*h*	.....	.....	.....
Boston	70.00	46.50	3.00	17.00‡	22.00‡	.07‡	.095‡	.09*h*‡	.12*h*‡	.075‡	.095‡	.125‡
Chicago	140.00	48.00	2.30	18.00	23.60	17.00*g*	22.00*g*	.07*h*	.11*h*	.05	.09	.135
Cincinnati	112.00	37.50	.....	13.47	17.47	.12	.....	17.00	.....	.051	.078	.....
Cleveland	3.75*a*‡	37.00	2.85	18.00	22.25	.081	.099	.091*h*	.101*h*	.06	.095	.10
Dallas	.....	32.50	.....	15.80	20.00	.05	.08	14.80	23.00	.05	.075	.105
Denver	.....	27.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	35.00	.....	16.72*f*	21.97*f*	.....	20.60*g*	15.60	20.60	.0535	.1125	.1525
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	11.00	15.16	11.00*g*	15.16*g*	11.00	.....	.042	.06	.12
Minneapolis	.....	.....	1.90*d*	21.70	26.70	.098	.137	21.85	34.65	.0638	.....	.....
Montreal	90.00*c*	60.00	3.42	14.00	20.00	.10	.13	.0975*h*	.01125*h*	.0675	.135	.165
New Orleans	.....	.....	.....	14.00	17.00	.065	.09	.07*h*	.10*h*	.....	.078	....
New York	.....	67.00	2.85	15.10	20.50	.06	.085	.07*h*	.10*h*	.....	.075	.11
Philadelphia	120.00	.....	.....	15.00	20.00	.06	.085	.065*h*	.095*h*	.055	.07	.10
Pittsburgh	115.00	40.00	.....	19.00	24.00	.077	.1125	.068*h*	.121*h*	.0675	.....	.....
St. Louis	115/130	37.00	.....	19.00	24.00	.0775	.1075	.08*h*	.11*h*	.045	.09	.12
San Francisco	.....	70.00	.....	12.00	18.00	12.00*g*	18.00*g*	12.50	23.00	.04	.0575	.117
Seattle	.....	60.00*i*	.....	5.55	25.55	19.50*g*	25.55*g*	15.50/16.50	28.50	8.15*g*	.075	.1325

‡Delivered. *a* 4½x6x5½ in. per sq. yd. delivered. *b* 4x5x9 in. aver. *c* Sales tax included. *d* 2½ in. 6 to 8-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican. *g* Per ton. *h* Per gallon. *i* 3½x4x8½ in.

(*Continued on following page*)

(Continued from page 913)

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¾-in. billet *b*	RIVETS ½-in. structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle bars	Std. spikes *c*	Tie plates *c*	Track bolts
Birmingham	$2.40	$2.60	$3.70	$2.55	....	$42.50	$43.00	$42.00	$2.80	$3.15	$2.30	$4.35
Chicago	2.30	2.60	3.70	2.80	$2.70	42.50	43.00	42.00	2.80	3.15	2.30	4.35
Pittsburgh	2.25	2.55	3.60	2.75*d*	2.60	42.50	43.00	42.00	2.80	3.15	2.30	4.35
Buffalo	2.35	2.60	....	....	....	....	....	....	....	....	2.30	....
Cleveland	2.445‡	2.60	....	....	....	....	....	....	....	....	....	....
Youngstown	....	2.60	....	....	....	....	....	....	....	3.15	....	....
Gulf ports	2.65*a*	2.95*a*	....	....	3.05*a*	....	....	....	....	....	....	....
Pacific ports	2.80*a*	2.95*a*	....	....	3.05*a*	....	....	....	....	3.15	2.40	....

‡ Delivered. *a* F.o.b. cars dock. *b* For rail steel deduct 15c. from billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per c.l.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¾ in., base price 15 tons or over *b* New billet	Rail steel	Add $/cwt. for Switch	Del.	EXPANDED METAL LATH Per 100 sq.yd., carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 s.f., carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6 x 6 wires Per sq. yd.	SHEET PILING Per 100 lb base price
Atlanta	$3.65	$2.82	$2.67	.02½	.10	$21.00	$23.00	$1.75	$1.31	$0.1692	$2.60
Baltimore	3.70	2.92	2.77	....	.10	23.00	25.00	1.62	1.22	.1566	3.00
Birmingham	2.40*a*	2.60	2.45	.02½	.10	22.50	24.50	....	....	.....	....
Boston	4.07	3.03	2.88	$20 C.L.	.10	21.60‡	23.60‡	1.68	1.26	.1620	3.02
Chicago	2.30*a*	2.60	2.45	.03	.05	23.00	25.00	1.61	1.22	.1557	2.70
Cincinnati	3.95	2.815*c*	2.665*c*	....	.05	21.50	23.50	1.60	1.21	.1548	....
Cleveland	3.86	2.60	2.45	.02½	.10	22.50	22.50	1.59	1.20	.153	....
Dallas	2.45	3.335	3.185	....	....	.....	.....	1.86	1.38	.1791	2.85
Denver	4.48	4.00	3.85	....	....	23.50	25.50	1.87	1.38	.1809	....
Detroit	3.96‡	2.71	2.56	....	.10	22.50	24.50	1.62	1.22	.1566	2.875
Kansas City	4.24	3.02*c*	2.87*c*	.0	.05	20.50	22.50	1.82	1.29	.1665	3.13
Los Angeles	3.825	2.95	2.80	.02½	.05	23.00	27.50	1.89	1.40	.1827	3.72
Minneapolis	4.00‡	2.90*c*	2.75*c*	.0	.10	26.00	30.00	1.71	1.28	.1656	3.00*d*
Montreal	2.90	2.40	2.40	....	....	33.00	34.00	2.50	1.82	.253	3.50
New Orleans	....	2.94	2.79	.05	.10	21.00	23.00	1.76	1.31	.1701	....
New York	3.97	2.88	2.73	....	.10	21.50	23.00	1.67	1.26	.1584	2.93
Philadelphia	3.90	2.84	2.69	....	....	22.50	24.50	1.63	1.23	.1575	2.89
Pittsburgh	2.25*a*	2.55	2.40	.02½	.10	20.50	23.50	1.55	1.18	.1494	2.60
St. Louis	3.99	2.87	2.72	.0	.05	22.00/24.00	24.00/26.00	1.62	1.21	.1566	2.70
San Francisco	3.95	2.95	2.80	.02½	.10	25.50	27.50	1.89	1.39	.1827	3.50
Seattle	3.10	2.95	....	....	....	25.50	27.50	1.89	1.39	.1827	3.05

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.*a*	VITRIFIED SEWER PIPE Per foot, delivered, 8 in., s.s.	12 in., s.s.	ASTM 24 in., d.s.	C13–35 36 in., d.s.	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTM C 14–35 12 in.	24 in.	WROUGHT STEEL PIPE Full standard weight. *h* 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$50.00	$0.26*bc*	$0.468*bc*	$1.69	$4.50*c*	$85.00	$128.00	$0.45	$1.625	44.5	35.5	42	32.6
Baltimore	53.50	.30	.55	2.40	6.90	110.00	170.00	.40	1.60	....	....	....	....
Birmingham	46.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	64.5	55.5	62	52.5
Boston	53.50	.224	.432	1.98	5.8425	99.00	153.00	.45	2.50	....	....	....	....
Chicago	54.50	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.48	52.5	41.25	50.625	37.5
Cincinnati	53.00	.203	.3915	1.665	5.0225	75.00	120.00	.60	1.90	52.6875	41.4375	49.5625	37.6875
Cleveland	54.50	.154	.297	1.26	3.9975	69.00	108.00	.36	1.80	56	44.5	51.5	40.5
Dallas	58.00	.40	....	....	....	160.00	260.00	.46	1.57	69.5	61.5	67	58.5
Denver	66.00	.29†	.50†	2.10†	....	130.00	220.00	....	....	44	33	41	29
Detroit	52.60	.203	.3915	1.71	5.2375	76.50	130.00	.33	1.50	53.2	41.9	50.1	37.8
Kansas City	56.00	.30	.54	2.16	5.00	120.00	240.00	.45	1.60	48.8	37.5	45.6	33.8
Los Angeles	54.50	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	57.1	48.1	54.6	44.6
Minneapolis	57.00	.24†	.432†	1.728†	4.60†	.....	.....	.65	1.75	....	....	....	....
Montreal	55.00	.33†*e*	.59†*e*	2.04†*e*	....	82.00	134.00	.51	2.04	....	....	....	....
New Orleans	50.80	.26	.468	1.69	....	150.00	220.00	.45	1.65	....	....	....	....
New York	53.00	.27	.55	2.25	5.84	.....	.....	.50	1.50	52.49*i*	41.53*i*	48.20*i*	37.80*i*
Philadelphia	50.00	.224	.45	2.25	6.00	150.00	180.00	.54	1.80	64.5*i*	55.5*i*	62.*i*	52.5*i*
Pittsburgh	56.00	.182†	.351†	1.62†	4.92†	97.80	154.20	.85*g*	2.00*g*	64.5*j*	55.5*j*	62*j*	52.5*j*
St. Louis	53.00	.28	.504	2.016	3.96	85.00	170.00	.75	1.80	51.125	39.875	48	36.125
San Francisco	55.00	.315*d*	.567*d*	2.268	5.67	103.50	172.50	.45	2.50	53	44	42.75	33.33
Seattle	55.50	.294	.441	2.142	5.355	68.00	160.00*f*	.60*f*	1.60*f*	37	27	37	24

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N. J. (base) $50.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* Sales and municipal taxes extra. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list for delivery from warehouse, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¼ in., 8½c.; ⅜ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. *i* Resale price to consumer, car load lots shipped from mill. *j* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Buttweld — 1 in. and 1¼ in. black 30, galv. 14; 1½ in. black 34, galv. 16½; 2 in. black 33½, galv. 16. Lapweld — 2½ in. to 3½ in. black 27½, galv. 12½; 4½ in. to 8 in. black, 28½ galv. 15.

(Continued on page 28)